ARMY RESEARCH AND DEVELOPMENT

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196 Authors Listed on 96 Papers for Army Science Conference

Rivals for the honor of being selected to present a technical paper at the 1968 Army Science Conference, June 18-21 at the United States Military Academy, West Point, N.Y., submitted a record number of 474 narrative summary proposals for screening within their agencies.

Based on recent evaluations by the respective major commands in accordance with quotas established by the Army Science Conference Advisory Group, 96 papers have been selected for presentation. They are representative of 196 authors and coauthors.

An additional 15 papers are in the supplementary category, to be used as alternates if necessary and also to broaden recognition of meritorious research.

U.S. Army Materiel Command researchers desirous of reporting on scientific investigations conducted within in-house

(Continued on page 4)

Order Clarifies Sentinel, Nike-X Managers' Duties

Responsibilities of Lt Gen Alfred D. Starbird for the Sentinel System, a Communist Chinese-oriented antiballistic missile system, and of Lt Gen Austin W. Betts for continued development of the Army's Nike-X System were detailed in recent announcements.

Secretary of Defense Robert S. McNamara announced that General Starbird's assignment as U.S. Army System Manager for the Sentinel System was effective Nov. 15, although he will continue to serve until February as director of the Defense Communications Agency, Washington, D.C.

General Starbird's organization, consisting of three main elements, will be responsible for development, production and timely deployment of the Sentinel System to provide a defense against the threat of the Communist Chinese ICBM force of the mid-1970s.

General Betts became Nike-X System Manager in October 1966 in addition to his assignment as Chief of Research and Development. He will direct a new Nike-X R&D Class II activity being

(Continued on page 3)

DAR Ostrom Promoted To Brigadier General

CHIEF OF R&D Lt Gen A. W. Betts congratulates Director of Army Research Brig Gen Charles D. Y. Ostrom Jr. on promotion. **(See story page 3.)**

Human Factors R&D Meet Draws 250 Participants

Progressive impact of the social and behavioral sciences in applications to Army operational requirements was reported and discussed by nearly 250 participants in the 13th annual U.S. Army Human Factors Research and Development Conference.

General James K. Woolnough, CG of the U.S. Army Continental Army Command, gave the keynote address at the 3-day session conducted at the U.S. Army Signal Center and School, Fort Monmouth, N.J. The conference was sponsored by Chief of Research and Development Lt Gen Austin W. Betts.

General Woolnough discussed the relationship of CONARC's mission and the Army research and development activities, with special reference to the importance of prompt application of the techniques of the social and behavioral

(Continued on page 4)

Besson Stresses Creativity to Lab Leaders

Break with precedent when necessary to develop creative concepts for new weapon systems and materiel for success in combat, General Frank S. Besson Jr. advised about 100 participants in the U.S. Army Materiel Command Third Laboratory Conference.

Speaking at the National War College at Fort McNair, Washington, D.C., in keynoting the Nov. 6-7 meeting, the commanding general of the Army Materiel Command said breaking with precedent to produce significant discoveries "is extremely important to the AMC mission."

AMC Laboratories, he said, "are the bridge between requirements and the best possible materiel that we put in the hands of troops. . . . One of your important jobs in the lab is serving as technical advisers to my 57 project managers. . . . You people in the labs have a vital role to play in these projects. I would appreciate your redoubling your efforts to assist these project managers. . . ."

General Besson reemphasized the authority he has delegated to Dr. Jay Tol Thomas, AMC Deputy for Research and Laboratories, by saying: "He is my deputy and a member of the command group. He is in direct line of command below me, and he expresses my concern and my

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Featured in This Issue . . .

Project THEMIS Bids Delayed

The second phase of Project THEMIS has been delayed by approximately 30 days from the schedule announced on page 42 of our October 1967 issue.

The revised schedule requests institutions to submit preliminary proposals for research to the Department of Defense by 19 January 1968.

Contrary to a previous report, the number of new research programs to be selected has not been determined. Project THEMIS is the Department of Defense program to expand centers of scientific excellence in the nation's academic institutions.

Army R&D Newsmagazine

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Purpose: To improve informal communication among all segments of the Army scientific community and other Government R&D agencies; to further understanding of Army R&D progress, problem areas and program planning; to stimulate more closely integrated and coordinated effort among Army R&D activities; to express views of leaders, as pertinent to their responsibilities, and to keep personnel informed on matters germane to their welfare and pride of service.

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OTHER GOVERNMENT AGENCIES' requirements should he submitted directly to the Army Research Office, OCRD, Department of the Army, Washington, D.C. 20310, ATTN: Scientific and Technical Information Division.

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DoD Revises Microelectronics Policy

Department of Defense policy on the use of microelectronics in military systems and equipment will be delineated for Army agencies in a TAG (The Adjutant General) letter scheduled for distribution this month.

Principles of the policy were submitted for coordination of the Military Department agencies concerned by Department of Defense (DoD) memorandum dated Apr. 14, 1967, and updated by an Oct. 20 memorandum.

The revised policy superseded DoD memorandums issued in 1963 and 1965. It relates microelectronics more directly to design applications, specifications and standardization, procurement, maintenance and logistics.

As stated by the Assistant Secretary of Defense (Installations and Logistics) and the Director of Defense Research and Engineering, the ultimate objective is "to provide equipment which satisfactorily fulfills the military need with a high probability of no failure for the entire lifetime of the equipment or system."

The memorandum to secretaries of the Military Departments states:

"The considerable improvement in reliability offered by the microelectronics, the savings in space and weight, and potential cost reduction, make it most desirable to promote the widest possible appropriate use of microelectronics in military systems.

"Further, the reliability of microelectronics circuits is sufficiently high to warrant packaging of several, or even many, such circuits into modules of which repair is neither practical nor effective. Such design modules, to be discarded upon failure, would reduce logistic support costs and further improve reliability."

In an Oct. 18 address before the International Electron Device Convention, Dr. Finn J. Larsen, Principal Deputy Director of Defense Research and Engineering, said the policy memorandum was issued after careful consideration in the Department of Defense and much consultation with industry, including the National Industrial Association.

The new policy requires that all new projects in the advanced, engineering or operational development categories shall consider use of microelectronics technology in design.

This policy is not intended to demand arbitrarily the use of microelectronics. Rather, it directs an objective appraisal of all factors concerning the system/equipment design relative to current microelectronics technology, with the view of maximizing reliability and minimizing total cost of ownership, weight and space.

In addition to the module discard-on-failure concept, several other concepts for maintenance and logistic support must be considered during the design and follow-through phases, according to the memo.

One such concept would be logistic self-support, wherein built-in redundancy may substitute for replacement and repair, or replacement modules accompanying the equipment may be procured in sufficient quantities to support the total life expectancy of the equipment.

The policy favors intrasystem standardization, but opposes intersystem standardization. It explains:

"Considering the present microelectronics technology along with the maintenance and logistic support concepts, standardization of replacement modules within a specific equipment or system is a design objective secondary only to system optimization. This intrasystem standardization will enhance the achievement of logistic self-support with a minimum number of replacement modules required to support the system/equipment for its total life span."

The requirement of and the design of standardized microelectronic circuits and modules for broad intersystem use is not favored because:

- **This can lead to undesirable constraints on the design of each succeeding specific system.**
- **The design and construction of each equipment can be optimized with little extra cost or logistic support difficulty.**
- **The need and value of standardization for logistic aspects diminishes when, due to the life characteristic of microelectronics, logistics self-support can be achieved as opposed to logistic support through supply inventory.**

"Limited intersystem standardization may be appropriate," the memorandum states, "where the system designer of a new system selects previously acceptable microelectronics design for reuse, or where the DoD components direct commonality of microelectronics design with two or more systems concurrently under development.

". . . General standardization of microelectronics, whether via a general military, specification, standard or handbook, will be restricted at this time to the areas of (a) definition of terms; (b) parameters to be controlled for circuit characterization; (c) test level, including test methods and procedures; (d) general application guidance, and design criteria; and (e) preservation and packaging guidance.

"If it is necessary for DoD components to specify, prior to design, performance or physical characteristics of microelectronics circuits or modules for specific systems or equipment, such requirements will be included in the system or equipment specification rather than issued as separate circuit or module specifications.

"Microelectronics design requires a very close relationship between the equipment designer and the microelectronic device or module supplier. This factor has not been so critical in the past, using discrete device technology.

"The criticality of this factor in microelectronics demands an increase in the latitude allowed equipment and systems designers in the selection of circuits and techniques and the control of suppliers."

Order Clarifies Sentinel, Nike-X Managers' Duties

(Continued from page 1)

organized. This new element and the Sentinel System Office will be colocated in the Washington, D.C., area.

The Sentinel System will use 15 to 20 missile batteries in the United States for area defense. The Department of Defense, in announcing the first 10 geographical areas to be surveyed as possible site locations for the Sentinel System, stressed that the system will "give protection to all U.S. cities, not only those near missile site locations."

General Starbird's organization will include the Sentinel System Office as an element of the Office of the Chief of Staff, U.S. Army. A second element is the Sentinel System Command at Huntsville, Ala., which will "develop, procure and install the Sentinel System." The Sentinel System Evaluation Agency will be a third element headquartered at White Sands (N. Mex.) Missile Range for "independent evaluation, review and testing."

The Sentinel System Command will be an expansion of the Nike-X Project Office at Redstone Arsenal, Ala., with about 50 percent increase of staff to roughly 1,000 personnel. Existing directorates will remain, namely Advanced Development; Production and Logistics; Site Activation; and Engineering Development.

The Advanced Development Directorate, however, will report to General Betts as Chief of R&D but will remain collocated with the Sentinel System Command. Brig Gen Ivey O. Drewry, who has headed the Nike-X Project Office and served as Nike-X project manager, is now CG of the Sentinel System Command and deputy to General Starbird.

Brig Gen George Mayo Jr., who has served as Deputy Nike-X System Manager (Plans) under General Betts, is now Deputy Sentinel System Manager (Plans). The Nike-X System Office in Washington is discontinued and its personnel and resources transferred to the Sentinel System Office.

Department of the Army General Order No. 48, dated Nov. 15, 1967, states that the Kwajalein Test Site in the Pacific Ocean Marshall Islands is transferred from the jurisdiction of the CG of the U.S. Army Materiel Command to the Sentinel System Command. However, the National Range mission of the Kwajalein Test Site will continue to be performed under the management of General Betts as Chief of Research and Development.

GO 48 further states that "The mission of the Sentinel System Manager is to develop and, when so directed, assure timely, effective deployment of the Sentinel Ballistic Missile Defense System, and provide a single point of contact within the Department of the Army for coordination and direction of all activities pertaining to the Sentinel System."

Command of the Kwajalein Test Site is vested in Brig Gen Drewry under the guidance and direction of General Betts "with regard to the National Range mission." General Drewry will "exercise command over tactical Sentinel sites during the activation phase, until acceptance of the operational sites" by the CG of the U.S. Army Air Defense Command.

The Department of Defense explained that research and development of the Nike-X system "will continue separately from the Sentinel System. The objectives are to develop systems which will protect against the existing ICBM threat and to design equipment which will be used in testing the penetration capability of U.S. strategic defensive missiles.

Support to the Sentinel System organization as well as to the Nike-X development will be provided by the Army Corps of Engineers, the Army Materiel Command, the Strategic Communications Command, the Continental Army Command, and Army Air Defense Command.

In a news release dated Nov. 15, the Department of Defense announced that the first 10 geographical areas to be surveyed as possible site locations for the Sentinel System are in the vicinity of Albany, Ga.; Chicago, Ill.; Dallas, Tex.; Grand Forks Air Force Base, N. Dak.; New York City; Oahu, Hawaii; Salt Lake City, Utah; Seattle, Wash.; Boston, Mass.; and Detroit, Mich. Other areas to be surveyed will be announced later.

In most cases, the announcement said, sites being considered for the Sentinel System are on government-owned land. The surveys and tests will be conducted over a period of several months, depending upon results obtained and other factors such as weather and ground conditions.

DAR Promoted With Father's Unique Stars

In 1942, remote Bora Bora of the South Pacific Society Islands had no PX or uniform shop. In fact, there wasn't a base there at all — U.S. Forces were building one.

When Col Charles D. Y. Ostrom Sr., in command of "Bobcat Force," was promoted to brigadier general, his Force Engineer would not condone his new general officer to go — for months, perhaps — without benefit of the stars denoting his rank.

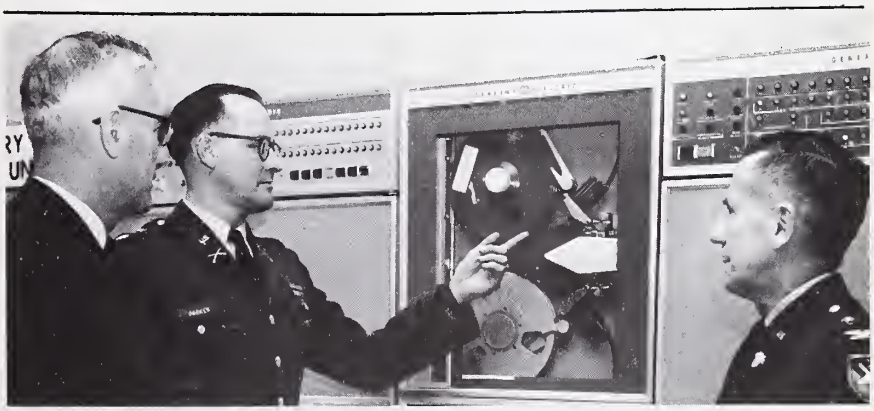
On an island mail run arrived a small flat box dated Feb. 23, 1942, "From: Force Engineer; To: CG, Bobcat Force . . . Congratulations. . . ."

The box contained two silver stars — not with the brilliant bevel of modern-day uniform devices, but they were perfect stars — fashioned from two U.S. 25-cent coins, with small safety pins soldered on the backs.

Brig Gen Ostrom Sr., who retired in 1950 and lives in San Francisco, Calif., years ago gave his first stars to his first son with the thought, if not the spoken words: "You'll wear these one day." On Nov. 1, 1967, his son did.

Chief of R&D Lt Gen A. W. Betts and Mrs. Ostrom pinned the 25-year-old stars on the shoulders of Brig Gen Charles D. Y. Ostrom Jr., Director of Army Research.

He wore them awhile, then General Ostrom replaced them with regulation stars but proudly carried his father's, still in the original box, for all who greeted him to see and hear the story of a 2-general Army family.



ARMY MATHEMATICS STEERING COMMITTEE (AMSC) Chairman Dr. Ivan Hershner, Maj John R. Parker, associate director for computers at the U.S. Military Academy (USMA), and Col John S. Dick, head of the USMA Department of Mathematics, discuss the academy's GE225 data-processing facilities at AMSC semiannual meeting. Dr. Hershner is chief of the Physical and Engineering Sciences Division, Office of the Chief of Research and Development. Col Dick, a member of the USMA's permanent faculty, is a brother of Lt Gen William W. Dick, commander of Allied Land Forces Southeastern Europe and former Army Chief of R&D. The AMSC assists in planning the Army's mathematics research program.

HFR&D Meet Draws 250 Participants

(Continued from page 1)

sciences to human factors involved in training and operations.

General Betts centered his remarks on the need for improving human performance through advanced training concepts soundly based in realistic knowledge of human reaction to psychological and physiological factors. The increasing complexity of man-machine systems, he said, calls for great progress in effective application of the techniques of the social and behavioral sciences.

Director of Army Research Brig Gen Charles D. Y. Ostrom Jr. and Brig Gen Thomas M. Rienzi, CG of the Signal Center and School, spoke at the banquet. They emphasized that social and behavioral scientists must educate not only the elements of the Army which are concerned with human performance, but also the academic community, industry, the U.S. Congress, Department of Defense, and society at large, and to "do it with enthusiasm."

Dr. Lynn E. Baker, conference chairman and U.S. Army Chief Psychologist, assigned to the Behavioral Sciences Division, Army Research Office, Office of the Chief of Research and Development, spoke on "Major Categories of Operational Objectives and Related Behavioral and Social Science Requirements." He summarized the stated objectives of the Joint Chiefs of Staff and the Army General Staff in applying social and behavioral research to operational goals.

Among programed speakers were Dr. Charles Hersh, Directorate of Personnel Studies and Research, Office of the Deputy Chief of Staff for Personnel (ODCSPER); Col Charles L. Crain, Directorate of Military Personnel, ODCSPER; Col Warren P. Davis and Harry I. Hadley, Personnel Management Development Office, Office of Personnel Operations, HQ Department of the Army; Lt Col W. C. Lowry Jr., Directorate of Doctrine and Systems, Assistant Chief of Staff for Force Development; and

Seymour Goldberg, Directorate of Evaluation, Army Combat Developments Command; Col Louis A. Waple, John F. Kennedy Center for Special Warfare, Fort Bragg, N.C.; Dr. Joseph Zeidner, Dr. Thomas Jeffry and Seymour Ringel, U.S. Army Behavioral Sciences Research Laboratory; Col John A. Ely, U.S. Army Automatic Data Field Systems Command; Dr. Richard L. Krum, Bunker-Ramo Corp.; Joseph A. Levy, U.S. Army Electronics

APG Innovations Cut Test Time on Artillery

Time required to test fire 175mm gun tubes and 8-inch howitzer tubes has been reduced by two innovations at Aberdeen (Md.) Proving Ground (APG). The procedures eliminate an inspection bottleneck and safety hazard after the guns are fired.

Development of a quick-change support to replace the standard mechanism supporting arch of the M107 self-propelled, full-tracked vehicle has cut the firing time in half. A tube can now be tested every seven minutes.

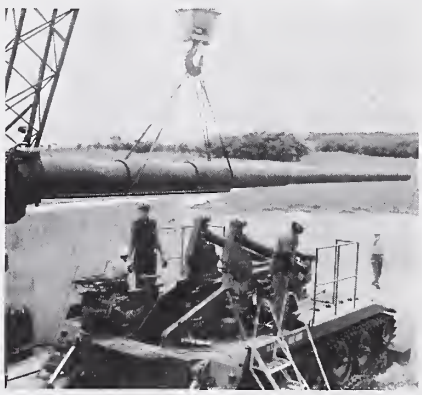
Previously, a 20-ton overhead crane and a 10,000-pound crane were required to maneuver a gun into the recoil mechanism of the M107 carriage. Once the cannon was mounted on the M107, the vehicle had to be driven a mile and a half to the firing site.

Flat-bed tractor-trailers, carrying three tubes each, haul the weapons to the firing range test site. A 50-ton mobile crane hoists the cannons individually off the truck and places them in the hydraulically operated recoil mechanism of the stationary M107.

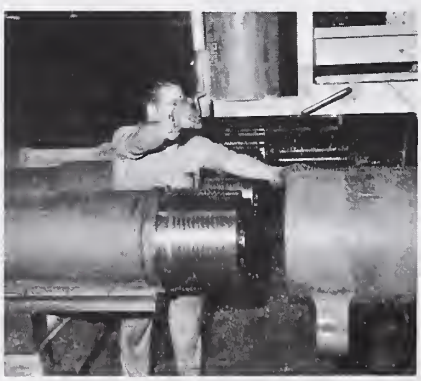
Another innovation is a new method of removing breech rings. Rings formerly were removed for inspection by an overhead crane, using a sling arrangement; now they are quickly taken off the tubes at ground level with a breech ring remover mounted to the front of a forklift truck.

The device consists of an old firing block suspended from a ball joint and ground to fit the grooves of the ring. A counterbalance keeps it level and the ball joint permits it to swivel and engage the threads smoothly. Driven by pneumatic air, the attachment is rotated into place, a lock bar inserted, and the ring removed.

Col Paul A. Troup Jr., director of Development and Proof Services, said every 175mm and 8-inch howitzer tube and breech mechanism currently entering the Army inventory is being tested at APG.



175mm gun is lowered into hydraulically operated recoil mechanism of an M107 full-tracked carriage at Aberdeen Proving Ground, Md. A quick-change support bar permits test firing a gun every seven minutes at APG's Development and Proof Services.



Development and Proof Services employe guides a breech ring removal procedure. Mounted to the front of a forklift truck, the newly developed breech ring remover eliminates an inspection bottleneck and safety hazard.

196 Authors Listed On 96 ASC Papers

(Continued from page 1)

laboratories accounted for 402 of the narrative summaries. Seventy-five were chosen for presentation and nine are in the alternate category.

The Office of the Surgeon General and the Office of the Chief of Engineers each will be represented by nine presentations and two alternate papers. Three presentations and two alternate papers are from other agencies.

Priority interest in research to improve communications and systems utilizing advanced electronics is reflected by 12 papers in this field that will be presented by personnel of the U.S. Army Electronics Command, Fort Monmouth, N.J. Edgewood Arsenal, Md., is next in line with eight papers.

The Army Missile Command and the Natick (Mass.) Laboratories each will be represented by six papers. Five of the nine papers authored by personnel of the Office of the Surgeon General will be representative of work at Walter Reed Army Institute of Research.

About 500 R&D administrators, scientists and engineers of the Army, other U.S. Government agencies, and foreign governments associated in the Quadripartite Standardization Program Agreement are expected to attend the 1968 Army Science Conference. Leaders of the R&D and defense establishments of Great Britain, Canada and Australia will be invited.

Dr. William G. McMillan, distinguished scientific adviser to General William C. Westmoreland, commander of the U.S. Military Assistance Command and CG of the U.S. Army Vietnam, has accepted an invitation to give the keynote address on his observations of military requirements in Vietnam.

High-level leaders of the Department of Defense, the Army, industry and combat commanders recently returned from Vietnam will discuss "Medical Activities in Vietnam," and "Pacification Efforts in

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Command; Dr. Carl A. Silver and Miss Adele Farber, Franklin Institute; and

Dr. Nelson Spinks, Center for Research in Social Systems, American University; Lt Col Donald Stanley Marshall, Directorate of Personnel Studies and Research, ODCSPER; Brig Gen Robert H. Williams (USMC, Ret.) and Richard P. Joyce, Research Analysis Corp.; Dr. John McCrary, Human Resources Research Office, George Washington University; and

William K. Carr, Center for Research in Social Systems; Mrs. Emily J. Jones, John Erickson and Capt Russell M. Phelps, U.S. Army Human Engineering Laboratories; H. L. Williams, Martin-Marietta Corp.; Charles J. Anderson, Dr. Joseph Frank and Vincent A. Abbatiello, U.S. Army Signal Center and School.

The technical papers presented will be published in proceedings of the conference.

Government scientists, invited guests from industry, military scientists, and commanders and staff concerned with R&D in the behavioral sciences were among the conferees, representing 103 organizations and agencies.

Dignitaries included Maj Gen William B. Latta, CG, U.S. Army Electronics Command; Rear Adm Frank B. Voris, assistant chief for research and military medical specialities, Bureau of Medicine and Surgery, Department of the Navy; Brig Gen Orwin C. Talbott, assistant chief of staff for individual training, CONARC; and

Brig Gen Carlton Preer Jr., director for ROTC/NDCC Affairs, CONARC; Col A. J. Affleck, director of psychology, HQ Australian Army; Dr. Ruth Hoyt-Cameron, Defence Research Board of Canada; and Dr. J. C. Penton, assistant director for operational research and human factors, United Kingdom Ministry of Defence.

APG Scientist Probes Heat-Reflecting Paint

Solar heat-reflecting olive-drab paint developed more than two years ago at Aberdeen (Md.) Proving Ground is undergoing a new 2-way spectroscopic probe to exploit potential applications through improvement in an Army Materiel Command project.

Principal investigator for the AMC "Spectroscopic Properties of Organic Coating" research is Capt James J. McLeskey III, 1965 Duke University PhD in physical chemistry. He did similar research as a National Defense Education Fellow in Duke's graduate school.

Assigned to the Paint, Varnish and Lacquer Division of the Army Coating and Chemical Laboratory (C&CL) at Aberdeen, Capt McLeskey is exploiting a comparatively new parameter of organic coatings — spectral reflectance characteristics invisible to the eye. He uses two spectrophotometers to characterize the reflectance of organic coatings exposed to visible, ultraviolet and infrared radiation.

Recent spectroscopic findings include need for a white undercoat to give the olive-drab paint maximum heat rejection. A new white paint has been developed that will replace, with one coat, the multiple white coats of conventional paint previously required.

A new gray paint with similar heat-reflecting properties also has been formulated. The early olive-drab heat-reflectant paint has been used for some months in Vietnam on Hawk missiles and refrigerator vans.

The C&CL is the Army's primary research and development activity for studying organic coatings, cleaning and paint stripping compounds, automotive chemicals, and fuels and lubricants.

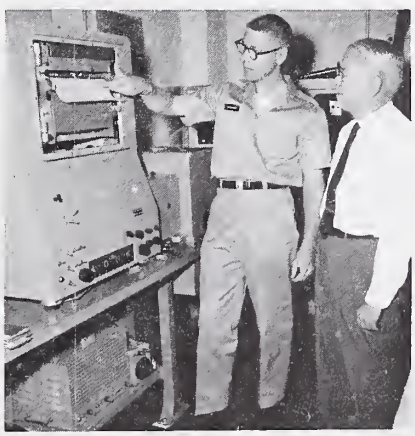
Capt McLeskey directs other scientific personnel in formulating coatings and measuring reflectances. He also coordinates development of a digital data recording system to aid computer processing and storage of experimental data.

As a result of data developed in the reflectant-paint program, a paint was prepared for an Army contractor, Aircraft Armaments, Inc., for a new Redeye moving target simulator. Rapid response in providing this paint won plaudits for the C&CL developmental team.

Capt McLeskey entered the Army in 1966 as a first lieutenant under the ROTC program and completed the Ordnance Officer Basic Course at Aberdeen before assignment to the C&CL.

Before his military service, he was a chemist at Redstone Arsenal, Ala., and a physical chemist for the Miami Valley Laboratories of Proctor and Gamble, Cincinnati, Ohio.

He received a BA degree in chemistry from Rice University, Houston, Tex., and is a Phi Beta Kappa. He is coauthor of several articles on chemistry in scientific journals.



Capt James J. McLeskey III discusses with Dr. Charles F. Pickett, technical director, Coating and Chemical Laboratory, Aberdeen Proving Ground, Md., reflectance characteristics of paint recorded on infrared spectophotometer.

AVLABS' Role Shown By Contracts Scope

Aircraft research projects sponsored by the U.S. Army Aviation Materiel Laboratories (AVLABS), Fort Eustis, Va., range from investigating new materials for rotors to fabricating casualty-lift capsules.

The largest in a series of recently awarded contracts is $200,000 to the Vertol Division of the Boeing Co. for testing the suitability of an advanced geometry glass fiber-reinforced plastic rotor blade.

Advantages claimed for the new blade include superior aerodynamic performance, elimination of corrosion problems and better structural characteristics. The material allows the designer to tailor the airfoil to optimum aerodynamic contours.

Prior to flight testing, rotor blade components will be subjected to various types of structural tests to determine fatigue stress qualities, natural frequencies and bonding adequacy. Preflight tests also will be conducted on a whirl tower. Flight test data on an updated CH-47 helicopter will be compared with results of tests using metal rotor blades.

Rotors are also the subject of a $76,000 wind tunnel investigation by the Bell Helicopter Co. of full scale, semirigid, 2-bladed rotors at high advance ratios. Bell was awarded a $63,800 contract to evaluate elastomeric bearings and to investigate the bearings characteristics in a UH-1 helicopter tail rotor assembly.

The program will establish the potential of the bearings in eliminating lubrication, reducing maintenance, and increasing the service life of the tail rotor system.

In searching for better methods to produce lighter, stronger and more reliable gears for aircraft power transmission systems, AVLABS awarded a $89,500 contract to Sikorsky Aircraft Division, United Aircraft Corp., to evaluate three advanced gear fabrication models.

The program will determine differences in the strength of the gears produced by each of the processes, the strength increase over conventional gears, and of the relationship of the strength differences on the internal properties of the gear material after forging.

Another study will pinpoint specific component areas in which significant advances in vertical/short takeoff and landing (V/STOL) propeller and propeller reduction-gear technology can be made.

Hamilton Standard, a division of United Aircraft Corp., received a $72,000 contract to investigate the feasibility of utilizing new materials and techniques which will provide significant weight reductions in the design of a propeller system compatible with a 1,500-2,000 shaft horsepower turbine engine.

A year-long study to gain an under-

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Draft Regulation Outlines Design, Testing Climatic Criteria

Army Regulation 705-15, "Operation of Materiel Under Extreme Climatic Conditions," currently being staffed, presents the U.S. Army policy concerning consideration of extreme climatic conditions in research, development, testing and evaluation of military materiel.

Revised and enlarged to incorporate the latest information, the AR has been prepared to incorporate provisions of Quadripartite Standardization Agreement (QSTAG) 200, *Climatic Factors Affecting Design Criteria*, which is being reviewed by the U.S. Army.

Preparation of the quadripartite document and revision of the AR both stem from recommendations of the Quadripartite Ad Hoc Working Group, based on field and office climatological studies of the United Kingdom, Canadian, Australian and United States Armies.

The U.S. Army member of this group is Dr. Arthur Dodd of the Earth Sciences Laboratory, U.S. Army Natick Laboratories. Responsibility for preparation and recommendation of environmental criteria for design and testing of military materiel was delegated to the Natick Laboratories by General Frank S. Besson Jr., CG of the U.S. Army Materiel Command.

Since the early days of World War II, the U.S. Army has applied increased knowledge concerning the natural environment to military design and testing. The latest revision of AR 705-15 is a logical step in continuing this policy.

The purpose of this article is to discuss briefly the new draft regulation and how it should be used. It differs from the current regulation in three important aspects:

First, there is more explanatory material to insure proper understanding and use of the document. Including is a more detailed explanation of policy matters, derivation of the climatic criteria, and the maps which are an important part of the regulation.

Second, the document now includes information on the joint occurrence of temperature, humidity and solar radiation expressed in diurnal cycles.

Third, there is more detailed consideration of hot and humid climates.

The revised draft is divided into four sections: I, Introduction; II, Climatic Conditions Affecting Design Criteria; III, Environmental Testing; and IV, Areas of Occurrence of Climatic Categories.

Section I, Introduction, has been expanded in an attempt to make clear the purpose of the document, to implement its proper use and to discourage its improper use. The regulation is not intended for guidance in issue of materiel which requires seasonal climatic considerations not treated in the document. The regulation also does not apply to equipment which is intended for use in a particular area.

Army policy of insuring effective use of standard equipment in the "intermediate" type climates and to provide for development of special purpose equipment, through special design or through modification of standard equipment to insure operation capability in the climates, is spelled out in Section I.

A new and important part of Section I, which is a direct outgrowth of the ABCA (American, British, Canadian, Australian) discussions, is the introduction of a risk policy which gives the user of the document more insight into the meaning of the limits of temperature and humidity set forth in the document.

The risk policy is a so-called "one percent policy," indicating that the high or low temperatures and humidities specified can be expected to occur one percent of the time in the most extreme month within the most extreme part of the area shown on the map.

Related to the risk policy is the definition of type of failure of military materiel. Degrees of reversible and irreversible failure are outlined. Where failure of an item is absolutely unacceptable, a different risk policy than that stated in the regulation will be in order and the Qualitative Materiel Requirement (QMR) or other pertinent document will specify the conditions which the item must be capable of meeting.

In Section II of the AR, eight Climatic Categories are delimited, representative of extremes of distinctive types of world climates to which military equipment may be exposed in operation or storage and transit. These Climatic Categories do not, in themselves, constitute design or testing specifications, but they do provide background information for the development of such specifications.

TABLE 1
Temperature, Solar Radiation, and Relative Humidity Diurnal Ranges For Consideration in the Development of Military Materiel

Climatic category	Climatic Condition				
	Operation			Storage and Transit	
	Temperature °F Diurnal Cycle	Solar radiation Btu/ft^2/hr	Relative humidity %	Temperature °F Diurnal Cycle	Relative humidity
1. Hot-dry	90 to 125	0 to 360	5 to 20	90 to 160	2 to 50
2. Wet-warm	Nearly constant 75	Not applicable	95 to 100	Nearly constant 80	95 to 100
3. Wet-hot	78 to 95	0 to 360	75 to 100	90 to 160	10 to 85
4. Humid-hot coastal desert	85 to 100	0 to 360	63 to 90	90 to 160	10 to 85
5. Intermediate hot-dry	70 to 110	0 to 360	20 to 85	70 to 145	5 to 50
6. Intermediate cold	-5 to -25	Negligible	High	-10 to -30	High
7. Cold	-35 to -50	Negligible	High	-35 to -50	High
8. Extreme cold	-60 to -70	Negligible	High	-60 to -70	High

Table 1, extracted from the AR, is a summary table which shows the range of temperature, solar radiation and relative humidity in each of the eight Climatic Categories. For example, Category 1 (hot-dry) has an operational temperature cycle from 90° F. early in the morning to 125° F. in the afternoon. The extreme "risk" value is 125° F. and is the value which was determined by application of the risk policy.

A map is included in the AR to show the areas of the world where the eight categories are applicable. The text and tables of the regulation contain full details of each climatic category, including climatic factors other than temperature, solar radiation, and humidity (such as precipitation, wind, air pressure and several more).

It is beyond the scope of this article to explain the derivation of the values included in Table 1 and discussed in more detail in the AR, but a short discussion of each of the eight Climatic Categories is in order.

Category I includes extreme conditions in the hottest areas of the world. Such conditions occur most extensively in the deserts of northern Africa, the Middle East and in portions of India and Pakistan. Less extensive areas subject to hot-dry conditions are found in the southwest United States and northern Mexico and in the interior of Australia.

One of the changes in the revised AR is an expansion of consideration of hot and wet (rainy) or humid (high humidity) climates. Climatic Categories 2, 3 and 4

represent the extremes of these conditions.

Category 2 (wet-warm) represents conditions under the canopy of heavily forested low-latitude tropical areas. It is characterized by a moderate temperature (75° F.) with little diurnal variation in association with very high relative humidities (near 100 percent) for long periods of time.

Climatic Category 3 (wet-hot) represents conditions in the same tropical areas as Category 2 but in the open rather than under the canopy. In these open areas, there is a diurnal variation of temperature and relative humidity.

Category 4 (humid-hot coastal desert) is representative of conditions in extremely hot and humid areas such as the coasts of the Persian Gulf and Red Sea, where moisture content of the atmosphere is at a maximum.

Areas subject to Category 4 conditions are not large but they are strategic. The combination of high temperature and high moisture content of the atmosphere causes a severe physiological stress and has a rigorous impact upon such equipment as electronic and electrical devices. These factors also are critical in considering design of environmental control equipment.

Delimitation of two categories of cold has been continued in the revised AR 705-15. Category 7 (cold) represents the extremes experienced in most of Canada, Alaska and a large part of Eurasia, where the minimum "risk" temperature is about -50° F. Category 8 (extreme cold) represents the conditions in the very coldest parts of North America, Greenland and in the "Cold Pole" centered in North Asia where the one percent risk minimum temperature is -70° F. Lower temperatures occur frequently in the interior of the Antarctic, but Antarctica is excluded from consideration in AR 705-15. Special purpose equipment usually is needed to insure operational capability in the areas of cold or extreme cold.

The Army policy is that most general-purpose items of equipment will be designed to withstand extremes of environment less severe than the extreme heat of the hot deserts or the very deep cold of the subarctic and arctic regions. The Climatic Categories developed to represent such conditions are referred to as the "Intermediate" categories in AR 705-15.

Category 5 (intermediate hot-dry) and Category 6 (intermediate cold) therefore constitute the primary categories for guidance in the research, development, test and evaluation of many items of military equipment. The "risk" temperature extremes of these categories are 110° F. and -25° F.

Section III of the AR is concerned with climatic testing to ascertain if the item in question will function during the occurrence of climatic extremes in the areas of intended use, including: (1) tests intended to simulate the natural environment in the testing chamber or laboratory, (2) field tests, and (3) tests which will give results similar to those of field tests, although the actual test involves subjecting the item to conditions more severe than conditions found in nature.

The Categories set forth in Section II of the AR provide guidance for developing climatic tests, but the categories do not constitute rigid test specifications. It must be recognized that currently it is not possible to duplicate completely the natural conditions.

Section IV, *Areas of Occurrence of Climatic Categories*, has been added to the revised document to explain the three world maps included. The primary map shows the areas where each of the Climatic Categories is applicable. The manner in which these areas were delimited and the manner in which the map should be used are discussed. The occurrence of the extremes of high temperatures and of low temperatures which have been reported are delimited on two additional maps. These maps are necessarily very generalized because of data limitations and the uneven occurrence of extremes.

The basic studies and the coordination required before AR 705-15 could be revised are but one example of application of environmental research to military problems which is a responsibility of the Earth Sciences Laboratory at Natick Laboratories.

The regulation is a general-purpose document and there are many special situations where it is not applicable or where application requires special guidance. Earth Sciences Laboratory scientists are available to discuss specific problems in application of environmental information to design and testing of materiel. Conducted on a modest scale, this service has been continuing for a number of years.

Direct communication between the environmental scientist and the designer or tester can save time and money and insure a realistic approach to the Army goal of supplying the soldier with environmentally suitable equipment. Such communication can prevent both over-design and under-design of equipment.

Experience indicates that this type of consulting usually can be accomplished quickly. In many cases, once the situation is discussed, the proper solution is apparent. But it is important that the environmental specialist understand the problem in detail before he recommends a course of action.

Army Employes 'Sit In' on Distant Classes

Electronic teaching devices that enable university instructors 200 or more miles away to instruct employes at Army installations in on-the-job training programs are being used by several Army commands.

Reports on this relatively recent innovation in instruction methods have come to the *Army R&D Newsmagazine* from the Army-Tank-Automotive Command, Warren, Mich., the Army Missile Command, Redstone Arsenal, Ala., and HQ Army Weapons Command, Rock Island Arsenal, Rock Island, Ill.

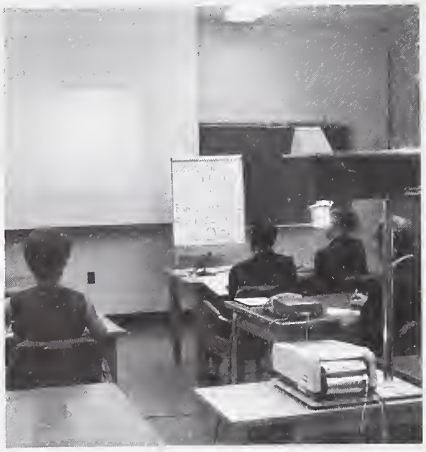
ATAC is conducting a large-scale program in cooperation with five major universities in the Detroit area to update the educational qualifications of veteran scientific and engineering employes, many of whom have not gone to school since receiving degrees 10 to 20 years ago.

Missile Command students, for example, actually "sit-in" at Redstone Arsenal on a graduate metallurgy course at the same time it is being taught to resident students at Auburn University — some 200 miles away. Not only are the MICOM employes in direct voice contact with the professor, but lecture notes are flashed on a movie screen at Redstone.

The professor writes material on the electrowriter at Auburn and it is transmitted over telephone wires to identical equipment at Redstone. A separate line carries his explanation of the material and permits students to ask questions.

Using similar equipment and techniques, the U.S. Army Weapons Command is allied with both the University of Illinois and the University of Iowa in a formal continuing education program. This fall, 17 courses are in progress at the Weapons Command. Student enrollment totals more than 450.

In these on-the-job training programs, as well as in night-school for-credit courses supported by the Army to improve the professional capabilities of personnel, the course must reinforce earlier knowledge utilized in performance of Army scientific and engineering duties.



ELECTRONIC TEACHING devices enable Army students to "sit-in" on courses taught at colleges and universities more than 200 miles away. On the screen is a formula transmitted along with lecture material. The students can ask questions through direct voice contact with the professor.

HDL Sponsoring Degree Programs for 42 Employes

Forty-two scientists and engineers at the Harry Diamond Laboratories (HDL), Washington, D.C., are participating in Army-sponsored advanced education programs at various colleges and universities, including the NATO von Karman Institute at Rhode-Saint-Genese, Belgium.

Richard N. Gottron, a fluidics specialist, is working for a PhD degree in mechanical engineering at the institute on a full-time, full-pay fellowship. He has been with HDL since 1960, first as a military officer with responsibilities as an R&D coordinator, then as a civilian in the Fluid Systems Branch, and was coauthor of the $1,000 first-prize technical paper at the 1966 Army Science Conference.

In February 1967, he was appointed a research and development supervisor, with responsibility for 17 employes in the branch. He has been engaged in coordinating the fluid effort at HDL with many other government agencies and industry.

Gottron has authored and coauthored several technical reports, including one in the area of noise reduction in fluid amplifiers. Several methods of reducing noise, as elucidated in the report, are now in practice or being investigated for possible use. Since 1965 he has been awarded three patents and has two pending.

Of the other HDL fellowship students, four are studying full time with full pay, seven full time with half pay, two full time without pay, and 21 part time with pay.

Four are attending graduate school at the American University in Washington, D. C. Kenneth E. Woodward is seeking a PhD degree in mechanical engineering and Morris Campi is studying for a PhD in physics. H. Douglas Huebner and Barry H. Scheiner are working on MS degrees in physics.

Albert D. Bender and Robert K. Dahlstrom Jr. are studying at Carnegie Institute of Technology for MS degrees in electronic engineering. Fred King is working for the same degree at Catholic University in Washington.

Others at Catholic University are Raine M. Gilbert and Daniel J. Lanigan, who are working for doctorates in physics, and Gerald N. Schultz and Roland P. Trask II, who are studying for MS degrees in mathematics and mechanical engineering, respectively.

Walter J. Brinks is working for a PhD degree in mathematics at George Washington University, where Bruck M. Fonoroff, Philip Ingersoll, J. David Pavlis, Robert M. Spickler and James Wong also are studying for MS degrees in electronic engineering.

Oklahoma State University has enrolled two HDL employes, Silas Katz, who is studying for a PhD degree in mechanical engineering, and Ronald K. Jantz, seeking an MS degree in physics.

Joseph Ali, Philip Emmerman and Andrew L. Haines are working on MS degrees in electronic engineering at Stanford University. At the University of Florida, Francis C. Deckelman is working for a PhD degree in electronic engineering. David Dance is studying physics for an MS degree at the University of Houston.

HDL students attending the University of Maryland are Walter F. Straub, seeking a PhD degree in electronic engineering; James L. Beard and Henry Lee, MS in mechanical engineering; and Mark J. Balas, Howard M Bloom, Dominick A. Giglio and J. Kent Haspert, MS in electronic engineering.

At the University of Wisconsin, Donald Alf, Phillip G. Brusius and Stanley G. Bruns are studying for MS degrees in electronic engineering. Philip M. Cowett Jr. is working toward an MS degree in electronic engineering at Virginia Polytechnic Instutute.

HDL has awarded five scholarships for BS degrees to young men who work for the laboratories during the summer and will return as regular employes upon graduation. This plan has provided HDL during recent years with many men who are now scientists, supervisors and administrators.

Currently enrolled in the plan are Paul A. Curro, aerospace engineering, University of Arizona; Gary C. Johnson, electronic engineering, University of Wisconsin; Leland R. Jones, mechanical engineering, Howard University; Henry S. Kimmel, mechanical engineering, University of Maryland; William Lemershewsky, electronic engineering, George Washington University; and David B. Sanders, physics, University of Virginia.

ECOM Develops Air Traffic Control System for SEA

Air traffic control in Southeast Asia is expected to be improved greatly by a new system developed under the direction of the Army Electronics Command, Fort Monmouth, N.J.

Known as the Air Traffic Control Communications Set AN/FSQ-75, it was accepted by the Army Nov. 22 from the Federal Aviation Administration's Department of Transportation at the FAA depot in Oklahoma City, Okla.

Col James G. McFadden, director of the newly organized Army Aeronautical Services Office, Cameron Station, Va., was the senior Army representative at the acceptance ceremony.

William J. Saker who works in the Army Electronics Command's Avionics and Navigation Aids Commodity Management Office, is responsible for the entire life-cycle management of the program. Robert Riehlman of the Avionics Laboratory has been responsible for design, development, and configuration features of the new system.

When installed in the existing Army tower structures at major Army airfields in Southeast Asia, the systems will provide Army Air Traffic Control (Army ATC) communications facilities enabling tower operators to perform procedural control of aircraft within and around the Army airfield terminal area.

Each system consists of four major elements: air-conditioned tower cab console equipment atop a fixed-tower structure an air-conditioned radio transmitting-receiving equipment shelter at the base of the tower structure, primary power generating equipment, and air-conditioned maintenance and supply shelters (AN/ASM-146 and 147), located near the radio equipment shelter.

This program was initially started in the spring of 1966 as a "Quick Reaction" project in which Tobyhanna (Pa.) Army Depot fabricated two systems for use in Southeast Asia. It was decided to increase the production rate by entering into an agreement with FAA for additional improved and certified FAA-type systems, designed and fabricated to their specifications but modified for Army use.

The recently created Army Aeronautical Services Office is the Department of the Army's executive agency for Air Traffic Regulation (ATR), Air Traffic Control (ATC), and flight information matters. The working partnership between the Army and the Federal Aviation Administration in provision of materials and services for the program is believed to be the first example of its kind.

The terms for cooperatively carrying out the Air Traffic Control Communications Set program are provided in a memorandum of agreement between the Army Electronics Command (NAT-376) and the FAA, effective last Feb. 3. Signers were Maj Gen W. B. Latta, CG of the Army Electronics Command, and Donald S. King, director of Installation and Material Service for the FAA.

This agreement provided for the FAA to provide to the Electronics Command for Southeast Asia engineering, fabrication, installation, training and support services for 22 of the complete air traffic control communications systems. The FAA will test and certify the installed systems prior to on-site acceptance by the Army.

A supplementary agreement by the Field Engineering Division, ECOM Materiel Engineering Directorate, provides for training Army uniformed and civilian personnel at the FAA Aeronautical Center in Oklahoma City.

Redstone Research Opportunities Advance Career Goals

Basic research opportunities provided at Redstone (Ala.) Arsenal, HQ U.S. Army Missile Command, are satisfactorily advancing career development objectives of three young scientists with PhD degrees.

Capt William N. Knopka and 1st Lts Leonard J. Kuzma and Frederick A. Hartman are assigned as research chemists in the Optical Spectroscopy Branch, Physical Sciences Laboratory, R&D Directorate. Each believes that his work contributes to the Army mission and enables him to progress in his professional field.

Capt Knopka began working at the arsenal in March 1966. Lts Kuzma and Hartman became members of the staff in recent months. "I consider my work here as equivalent to post-doctoral study," Capt Knopka said. "The work environment is probably more academic than in some universities, and we are allowed to conduct research within broad areas."

Lt Kuzma thinks he has been assigned to the work he is best qualified to do, with the result that "I feel I can contribute more to my job and advance myself professionally" - an opinion shared by Lt Hartman, whose interest is inorganic chemistry.

Graduated from Canisius College with a BS degree in chemistry, Capt Knopka earned his MS and PhD degrees, the latter in June 1965, from Seton Hall College where he was a research Fellow. He is a native of Buffalo, N.Y.

Lt Kuzma received a BS degree from Youngstown (Ohio) State University and studied at Notre Dame as a research assistant to earn a PhD in May 1967. Lt Hartman graduated from the University of Cincinnati with a BS degree and earned his doctorate in February 1966 at Notre Dame University.

Dr. James A. Merritt, chief of the Optical Spectroscopy Branch, said he has had the services of eight young officers with PhD degrees in the past few years, and that all have contributed significantly to the mission of the branch. He is particularly pleased with his current trio.

RESEARCH CHEMISTS (from left) 1st Lt Frederick A. Hartman, Capt William N. Knopka and 1st Lt Leonard J. Kuzma hold PhD degrees and are assigned to the Army Missile Command's R&D Directorate, Redstone Arsenal, Ala.

PhD Lt Typifies Talent Drawn to Missile Work

Typical of the numerous young Army officers with PhD degrees being attracted by research opportunities at HQ U.S. Army Missile Command, Redstone Arsenal, Ala., is 1st Lt Donald L. Smith, who received his doctorate in physics from Massachusetts Institute of Technology in 1966.

Graduated first in his class from the Army Ordnance Officers Basic Course at Aberdeen Proving Ground, Md., he selected Redstone Arsenal when asked to indicate his preference of assignments last September.

Lt Donald L. Smith

Finishing first in rugged competition is not a new experience to him. He graduated in 1962 from Georgia Institute of Technology in a 4-way tie for valedictorian honors and served on the mathematics faculty until he was granted a Shell Oil Graduate Fellowship at MIT.

Working currently with Dr. T. G. Miller, chief of the Radiation Physics Branch at Redstone Arsenal, 1st Lt Smith is conducting experiments in neutron polarization with a Van de Graaff accelerator. He also was a basic research assistant at MIT.

Looking to future career development, he is considering extending work in particle-gamma ray correlations, charged-particle polarization, and the feasibility of using the Van de Graaff acceleration for applied research on radiation damage to thin film and electronic components.

While at MIT he published a paper on his research in nuclear spectroscopy and has submitted two additional manuscripts for publication in professional journals. He is a member of several professional fraternities and the American Physical Society.

Carter Named USAETL Deputy

Col Colin M. Carter Jr. is the new deputy commanding officer of the U.S. Army Engineer Topographic Laboratories (USAETL), Fort Belvoir, Va. He succeeds Lt Col William R. Cordova, who has been assigned to Europe.

His last assignment was in Vietnam as commander of the 86th Engineer Battalion. He has served with the U.S. Army Strategy and Tactics Analysis Group, Bethesda, Md. (1963-66), and in Germany, France and Korea.

Col Carter graduated from the U.S. Military Academy in 1945, received a master's degree in civil engineering from Texas A&M College in 1953, and has attended the Army Command and General Staff College.

Young PhD Escapes Lab For Army 'Big Picture'

One of the Army's younger PhDs, analytical chemist Capt Paul Ricca of the Army Missile Command (MICOM), has "escaped" lab work by preference to get "the big picture" of Army development of missile systems.

Assigned as chief of MICOM's Land Combat Section of the R&D Directorate, he travels extensively as liaison between Army agency users and missile systems developers. His position in the Future Missiles Division requires that he and his staff stay "on top" of missile-related technology as well as with needs and reactions of user agencies.

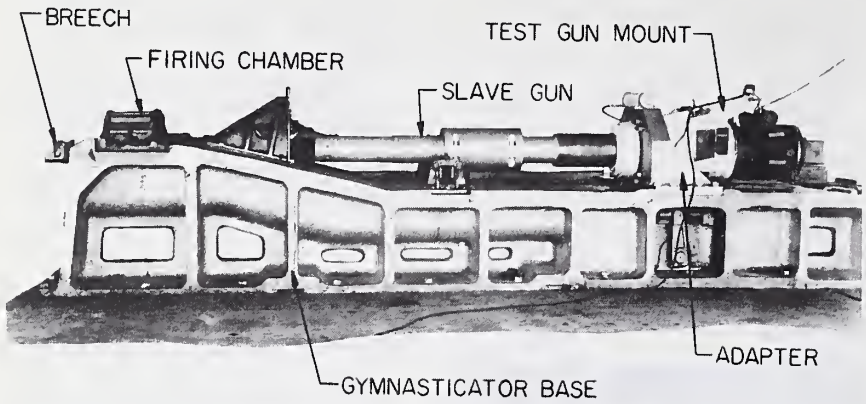
Capt Ricca says he prefers systems work to the chemical laboratory. He has made some 35 trips in the past two years for briefings to contractors, Department of Defense and other Army agencies in addition to providing assistance in field testing missile components.

Graduated with an AB degree in chemistry from Syracuse University in 1961, he received a doctorate in analytical chemistry from Purdue University in September 1965, when he entered the Army.

After a stint with the Army Ordnance Center and School, Aberdeen (Md.) Proving Ground, he was assigned to MICOM in January 1966. He is a member of several professional chemistry organizations and the American Ordnance Association.

ANALYTICAL CHEMIST Capt Paul Ricca explains boost recovery phase for the long-range missile concept.

Powder Gymnasticator Tests Systems



Rock Island (Ill.) Arsenal's powder gymnasticator is a strange-looking artillery piece that has never fired a projectile. Originally designed and for several years used purely for research, it has recently found a new application in proof testing of weapon systems.

When tested by the gymnasticator, the recoil mechanism, gun mount, breech, or other artillery component is made to "feel" the same reaction which would have been induced under actual firing conditions. The big difference between a "firing" of the gymnasticator and the firing of the real thing is that the firing cycle is reversed.

A firing chamber is located at the muzzle end of a gun tube. A small charge of propellant drives the gun tube and other recoiling parts rearward, duplicating the motion which is encountered during the reaction phase of the firing cycle.

This type of testing is necessary for artillery components because of the large amounts of energy generated during short periods of time. For example, the M107 self-propelled 175mm gun generates a breech force of more than 1,800,000 pounds in a time span of approximately nine milliseconds (nine thousandths of a second).

The firing of one round from the M107 takes about 55 pounds of propellant. But the gymnasticator can achieve the same breech force with only 1½ pounds of propellant.

The research and engineering facility of the Army Weapons Command installation had been using the powder gymnasticator for testing components for large-caliber guns and howitzers. It proved its value by enabling the technicians to conduct tests that were quicker, less expensive, more convenient, and as reliable as those involving artillery weapons at distant proving grounds.

The need for a proof acceptance tool led to a second look at the capabilities and limitations of the gymnasticator. An uncomplicated adaptor mechanism was designed by Rock Island Arsenal engineers to convert the gymnasticator to proof acceptance tests.

When they designed the adaptor, engineers took into consideration the parameters of the recoiling parts and firing chamber, including the bore diameter, length of stroke, volume of the chamber, type of propellant, and size of the powder charge.

Computations determined that 11 ounces of propellant would give the same effect in the gymnasticator as 11½ pounds of propellant would if fired from a 105mm gun; also, that precisely the correct quantity and type of propellant would duplicate firing chamber pressures, recoil mechanism oil pressure, length of recoil as well as the acceleration and velocity of recoiling parts.

Thoroughness of the proof acceptance programs which can be conducted with the gymnasticator is indicated by just one project improvement test. The purpose of this test was to find a more reliable counter-recoil spring as a component of the M140 mount. The M140 is used with the hard-hitting 105mm gun, which is the main armament of the M60 and M60A1 series of tanks.

During this series of product improvement tests, the gymnasticator was "fired" almost 20,000 times. But at the end of the test series, the engineers were certain they possessed data on a mount which was going to be a definite improvement over its predecessor.

The 20,000 "firings" of the gymnasticator provided confirmation of computations which led to design changes and improved maintenance procedures.

Product improvement testing on the M60A1 tank's counter-recoil springs typified the advantages of using the gymnasticator as a research tool. The test was conducted at the same site as the design agency and under its control.

Additionally, the time span for the test was considerably shorter than it would have been if the spring had been shipped to a proving ground, mounted in a gun, fired when it could have been scheduled on a long-distance firing range, the artillery disassembled, and the spring shipped back to the design agency.

The gymnasticator has other advantages. Since no projectile goes down the gun tube, there is no tube replacement due to wear; nor are there any projectiles to requisition, purchase, store and handle.

During the past year, the gymnasticator has proved its value as a proof-acceptance tool on mounts for the M107 self-propelled 175mm gun, recoil mechanisms for the M101A1 105mm howitzer, and recoil components for the M114 155mm howitzer.

Test of Our Generation

"The test of our generation will not be the accumulation of knowledge. In that, we have surpassed all the ages of man combined. Our test will be how well we apply that knowledge for the betterment of all mankind...."

President Lyndon B. Johnson

FOUR MILLION MAN-HOURS, with only four injuries during past fiscal year, earned Fort Detrick the U.S. Army Materiel Command (AMC) Award of Honor for Safety in 1967. Maj Gen Frank G. White, CG, U.S. Army Munitions Command (second from left) presents the Army's highest safety award to Col Peter G. Olenchuk, Fort Detrick CO. Present at the ceremony were (left) Dr. Riley D. Housewright, technical director, and Dr. Arnold G. Wedum, director of Industrial Health and Safety, Fort Detrick, Md.

Ballistic Research Labs Promote Dr. Lampson To Top Scientific Post

Chief Research Scientist of the U.S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, Md., is the new title of Dr. Curtis W. Lampson, who started his distinguished BRL career 21 years ago.

Promotion of Dr. Lampson to the newly created position enabled Dr. Robert J. Eichelberger to succeed him as technical director after serving since 1962 as associate director. Dr. Eichelberger was elevated to Public Law 313 status (10 U.S. Code 1581).

One of the finest acknowledgements of his professional stature as a U.S. Army career scientist was Dr. Lampson's selection as a member of The Army Research Council (TARC) when it was organized in January 1964 by joint action of the Assistant Secretary of the Army (R&D) and the Chief of Research and Development.

In addition to a primary function of developing Army long-range plans for Army basic research and exploratory development programs, TARC members serve on the Joint Advisory Panels of the Office of the Director of Defense Research and Engineering.

In his new position, Dr. Lampson will advise the commanding officer of the Ballistic Research Laboratories, act as liaison with the scientific community within and outside the Army, and continue with his research on air blast and shock tube physics.

Known as one of the nation's leading authorities on ground shock resulting from large explosions, he has been a frequent adviser to the U.S. Atomic Energy Commission and the U.S. Navy.

In 1946 he was chief of the air blast group for the Navy Bureau of Ordnance at the Bikini nuclear tests. The AEC selected him in 1948 and again in 1951 to organize, equip and direct a group in making blast measurements of atomic tests on Eniwetok Atoll.

Prior to serving as technical director at BRL, Dr. Lampson was chief of the Ordnance Engineering Laboratory and later chief of the Terminal Ballistics Laboratory.

Graduated from South Dakota State College with a BS degree in 1929, he earned MA and PhD degrees from Princeton University in 1935 and 1937.

DR. EICHELBERGER accepted appointment at BRL in 1955 as chief of the Detonation Physics Branch, 13 years after graduating from Washington and Jefferson College with a BS degree. He earned an MS degree in 1947 and a PhD degree in 1954, both from Carnegie Institute of Technology.

Scientific achievements earned him an Army research and development award in 1961, and he has received various other professional honors. Internationally known for his development and proof of a generalized theory of the form of jets by shaped charges, he has authored numerous articles in scientific and technical publications.

In recent years Dr. Eichelberger has been in increasing demand as an adviser and consultant to U.S. Government and other scientific agencies.

Dr. Curtis W. Lampson

Dr. Robert J. Eichelberger

Wrong Picture Published

Over the seven years that the Army Photographic Agency has been providing pictures for the *Army R&D Newsmagazine*, their record has been wonderfully cooperative and efficient. But somehow the wrong picture was furnished as that of Lt Col Boyde W. Allen Jr., new chief of the Space Branch, Nike - X and Space Division, on page 14 of the October edition. The editors regret this error. The correct picture is shown.

Lt Col B. W. Allen Jr.

BRL Launches Miniature Missile Models Minus Mounts

Miniature models of missiles can be launched directly into a high-speed air stream of a hypersonic wind tunnel, without using the customary mounting devices, by a new technique being developed at the Army Ballistic Research Laboratories.

Anders S. Platou, a research scientist, is heading the project at the Exterior Ballistics Laboratory, Aberdeen (Md.) Proving Ground.

"Elimination of the model support," he said, "makes it possible to obtain more accurate aerodynamic information on many of the ballistic shapes desired by the Army and, in turn, permits us to predict trajectories more accurately."

The experimental launcher is housed in an insulated, air-cooled chamber to protect it from wind-tunnel temperatures that range as high as 1300° F. To launch a model, air pressure in the chamber is raised to a previou .y computed level. Then doors are opened and an aluminum foil diaphragm is ruptured, permitting the sudden gust of pressure to propel the missile into the air stream.

The missile model is the only moving part. The system can fire both spinning and nonspinning models and accepts any shape projectile from ¼-inch to 1-inch in diameter up to 7½ inches in length. Models are built to oscillate several times during flight. The model shell is thin-walled (.001") nickel and has a heavy tungsten slug inside near its center of gravity.

Missile flights last 1/10 of a second in the tunnel, where wind velocities range up to Mach 9.2. Special cameras that operate at the speed of 4,000 frames per second record the flight.

Aberdeen Proving Ground is the Army's facility for research and experimentation in all phases of ballistics. As part of the U.S. Army Materiel Command, it operates under supervision of the Directorate of Research and Laboratories.

The USABRL staff of approximately 1,000 includes scientists and engineers whose knowledge and interests span the physical and mathematical sciences on which the design and use of Army weaponry are based.

RESEARCH SCIENTIST Anders S. Platou uses a missile model to point out symmetric doors of free-flight launcher being developed at the U.S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, Md.

USMA Professor Compiling Geographic Atlas of USSR

Geographic study in the Soviet Union this past summer by an assistant professor of Geography of the USSR at the U.S. Military Academy (USMA) is leading to the publication of a first-of-its-kind geographic atlas of the Soviet Union for USMA cadet reference.

Headed by atlas editor Maj Thomas F. Plummer Jr., who toured the Soviet Union extensively under a U.S. Army grant, officers of the USMA Department of Earth, Space and Graphic Sciences are assisting in the preparation of the atlas.

The reference work, expected to be completed by mid-1969, will contain approximately 100 map sections and 125 pages of text and photographs.

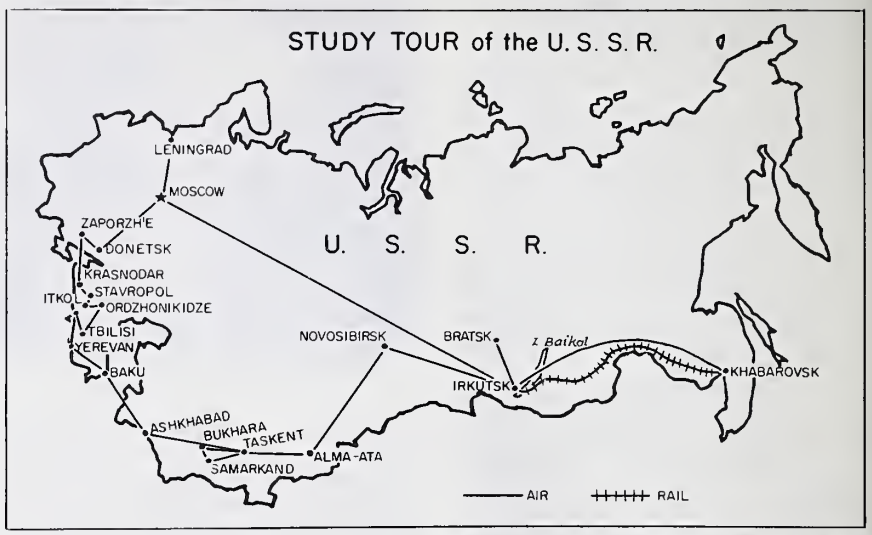
It will incorporate medium-scale topographic maps in color, photographs and text material organized on a regional basis. The atlas will provide, for the first time, cadet accessibility to a detailed view of geographic similarities and differences that exist within the USSR.

Such features as landforms, settlement patterns, economic activities and transportation networks easily found on the maps will provide the primary basis of regional comparison.

Maj Plummer traveled thousands of miles on the 50-day study tour in conjunction with *Intourist*, the Soviet tourist agency, and with a group of scholars from the U.S. and Canada specializing in the study of the Soviet Union. (See map above.)

More than 20 major cities were visited and numerous geographic conferences were held with the geographic institutes in various Republics of the USSR.

The tour, "The USSR for the Geographer," was organized by the Canadian Treasure Tours, Inc. of Montreal. It was led by Dr. David M. Hooson, professor of Geography at the University of California at Berkeley, author of *The Soviet Union, People and Regions*. Each city on the tour was carefully chosen by Dr. Hooson for its geographic significance.



The tour permitted first-hand on-the-ground study of the geography of the USSR as well as an opportunity to discuss many geographic problems with Soviet geographers.

In Ashkhabad, the capital of the Turkmen Republic, for example, a conference was held with the dean of the Geography Department of the Turkmen Gorki State University who discussed the ambitious Kara-Kum Canal project that will bring irrigation water more than 450 miles across the deserts of Central Asia to a point near the Caspian Sea.

Soviet solutions for such problems as sand dune stabilization were discussed. This type of information, much of which is unavailable in any published source, will be incorporated in a section of the atlas devoted to the Turkmen Republic.

On several occasions such conferences in various cities led to opportunities not usually offered visitors from the west. At Baku, the famous oil center, an 8-hour boat trip was taken in the Caspian Sea to visit an oil-drilling city of 5,000 inhabitants that has been built on pilings near the center of the Sea.

At Itkol, in the Caucasus Mountains, a difficult climb was made to the "snout" of an active alpine glacier near the foot of Mount Elbrus, the highest mountain in Europe. A 2½-day trip also was made on the Trans-Siberian Railroad from a point near the Pacific Ocean west to Lake Baikal, the deepest lake in the world.

One of the most valuable parts of the tour was the opportunity to photograph many aspects of the USSR that are of geographic interest. Each page of text in the USMA atlas will incorporate one or two representative photographs of the region discussed in the text and illustrated on the map above. Where possible, the exact location of where each photograph was taken will be shown on the maps.

Maj Thomas F. Plummer Jr.
Assistant Professor
Geography of the USSR
U.S. Military Academy

Readers of the Atlas then will be able to read about a section of the USSR, study that section on a map, and see photographs of the section as well. More than 1,500 photographs were taken on the tour. About 150 will be incorporated in the atlas.

Organization of the atlas will be based upon physiographic regions. A representative map section will be selected for each of the major physiographic regions of the country. The scale of each map section will be 1:250,000 and will cover a ground area of about 50 to 60 miles.

The analysis accompanying each map section will discuss the nature of man's environment and his activities as depicted on the map. The following excerpts illustrate the type of analysis that will accompany each map sheet.

These are from an early draft for the Kuban-Azov Plain section of the North Caucasus Region:

"Numerous swamps (E) are found along the lower course of the Kuban River west

KARA-KUM CANAL at Ashkhabad has been cut more than 450 miles through the desert from the Amu Darya River.

of the city of Krasnodar. A number of these swamps are former lagoons that once bordered the present Sea of Azov, but have since been filled with silt as the Kuban River's delta was built farther out into the Azov. One of these, Liman Kruglik (F), has been reclaimed for use as a rice paddy."

The letters (E) and (F) in the analysis refer the reader of the atlas to corresponding letters overprinted on the map at the precise map location of the feature to which they refer.

Maj Plummer is being assisted by Maj Todd P. Graham and Christian C. Thudium, also of the Department of Earth, Space and Graphic Sciences, as well as by several leading geographers from a number of American universities.

Chief adviser of the project is Theodore Shabad, editor of *Soviet Geography, Review and Translations* and author of *Geography of the USSR*. Several experts from the Army Map Service will also assist the project.

Middle Managers View Problems in Workshop

Middle managers of Army research and development activities at Edgewood (Md.) Arsenal and nearby Aberdeen Proving Ground convened at Edgewood Nov. 27 for a week-long workshop on R&D problems.

About 40 managers participated in the discussion of management practices and theories, gathering of information on which to base decisions, and planning for future research and development activities.

Among key speakers were Thomas L. Matthews of Reynolds Metal Co. and Dr. Wallace Culver of the staff of Montgomery Junior College, Rockville, Md. Matthews spoke on "Evaluation and Improvement of Management Potential" and Dr. Culver's subject was "Behavior Motivation, Effective Communications and Personal Maturity."

"Management Objectives and Long-Range Goals" was the topic of Donald Wittwer, U.S. Army Munitions Command, Dover, N.J. Robert Bruce of the Baltimore Field Office, Army Deputy Chief of Staff for Personnel, spoke on "Dynamics of Modern Organization for Management." Dr. William Wokoun, Human Engineering Laboratories, Aberdeen Proving Ground, discussed "Organizational Climate and Motivation."

USAEPG Names Acting Chiefs

The U.S. Army Electronic Proving Ground, Fort Huachuca, Ariz., recently named Lt Col Ralph E. Hill to serve as acting chief of the Test Directorate and Maj Raymond F. Bert to direct support activities. Both officers are recent Vietnam returnees and collectively have 46 years of active duty, including service in six campaigns.

WECOM CG Challenges Industrialists

An invitation, an appeal and a challenge were combined in Brig Gen William J. Durrenberger's address at the U.S. Army Weapons Command third annual R&D Advanced Planning Briefing for Industry, held at Moline, Ill.

The WECOM commander at Rock Island (Ill.) Arsenal put it this way: "The Weapons Command needs your help!" He spoke to more than 400 industrial executives on conceptual long-range requirements for weapons systems that can be achieved only through technological advances in numerous fields.

General Durrenberger emphasized that despite the great progress the Army has made in recent years in developing new or improved materiel, the need for improvement is continually being stated by the infantryman, the artilleryman, the tanker and the helicopter pilot.

In challenging the industrialists to turn the full force of technological advances to meet Army requirements, the general stressed the demand for "more firepower - more mobility - more protection - more accuracy - more night vision - more stability - more swimming capability."

Laboratory simulation of field and combat conditions is believed to offer the best possibility of reducing the lead time in proving out new and imaginative concepts for weapons systems. WECOM is turning more attention to this technique, he said, since it serves to reduce costs as well as saves critical time in development.

Dr. Colin M. Hudson was introduced by General Durrenberger as the new deputy for research and engineering and also the chief scientist of the Weapons Command.

WECOM Director of R&D Col Leonard M. Orman spoke on "Future Weapons." "Problems in Artillery, Small Arms, Aircraft Weapons and Combat Vehicle Armament," was discussed by Ed Horn, Rock Island Arsenal chief of research and engineering.

Dr. Chester W. Clark, former Director of Army Research and now vice president of Research Triangle Institute, discussed Department of Defense findings on "Project Hindsight," the retrospective study of recent sciences and technology used in developing of new weapons systems produced in recent years.

One of the briefing highlights was a question-and-answer panel headed by General Durrenberger. Col Orman was moderator and members were Dr. Hudson, Ed Horn, Frankford Arsenal CO Col Paul Nilsson, Army Combat Development Command Director of Materiel Col E. B. Kitchens Jr. and Watervliet Arsenal CO Lt Col M. A. Shadday.

"PROSIT!"—traditionally German but heard the world over, especially during the holiday season now upon us—is the toast of Army observers prior to taking their positions in Germany for initial tests of the United States-Federal Republic of Germany Main Battle Tank-70 (US/FRG MBT-70) and transporter. Organized as the U.S. Army System Test Manager's Office, MBT-70, Germany, the group will represent the CG of the U.S. Army Test and Evaluation Command (USATECOM), Aberdeen Proving Ground (APG), Md. Front and center are Col Jack P. Libby, USATECOM systems manager for US/FRG MBT-70; and Ray F. Wilkie, automotive engineer with Development and Proof Services (D&PS), APG. In the rear (l. to r.) are Lef W. Kenyon, project engineer from Yuma (Ariz.) Proving Ground; James W. Elsner Jr., mechanical engineering technician, D&PS; and S/Sgt Rolf M. Algermissen, interpreter-translator for the new office in Germany. In accordance with the basic agreement between the two governments for a cooperative tank development program, a counterpart German group is being deployed for similar purposes at U.S. Department of Defense proving grounds and test sites.

Col D. L. Howie

Lt Col C. McClure Sr.

Lt Col M. F. Ormond

Lt Col F. L. Taylor

OCRD Lists 8 New Officers, Civilians

Eight new personnel in the Office of the Chief of Research and Development include six officers and two civilians.

COL DONALD L. HOWIE, former deputy commanding officer of the Army Medical Service (AMEDS) Research and Development Command, has succeeded Col Tyron E. Huber as chief of the Life Sciences Division.

Col Howie was with the AMEDS R&D Command six years as chief of the Medical Research Branch, chief of the Plans, Programs and Funds Division, and as deputy CO. He also has served as deputy director of the Directorate of Medicine at the Walter Reed Army Institute of Research (*WRAIR*) and as CO of the 46th Surgical Hospital, Landstuhl, Germany.

Col Howie also has served as a consultant in hemotology, European Theater; Chief of Medicine, Fort Riley, Kans.; with the 1st Cavalry Division (Artillery) in Korea (1950-51); and varied other assignments.

After completing premedical training at the University of Iowa and the University of Pennsylvania in 1941, he earned an MD degree from the U. of Iowa. He was in residency training at WRAIR and Brooke General Hospital from 1952 to 1955. He has attended the Harvard Postgraduate School of Business Administration, has been awarded the coveted "A" prefix for outstanding professionalism in internal medicine, and has completed the Defense Management Course at the Navy Postgraduate School.

LT COL CLAUDE McCLURE SR., a specialist in neurosurgery, has been assigned to the Scientific Analysis Branch of the Life Sciences Division. He last served as assistant chief of neurosurgery at Fitzsimons General Hospital.

Col McClure was a surgeon with the 1st Infantry Division in Vietnam (1965-66), after a stint as CO of the 2d Medical Detachment there. He was a neurosurgeon at Brooke General Hospital, 1964-65, following two years at Edgewood Arsenal, Md., as chief of the Human Investigation Branch and the Division of Medical Research.

With BS and MD degrees from Wake Forest University, Col McClure instructed at Duke University 1953-56. After a year as an assistant in neurosurgery at the University of Tennessee, he earned an MS degree in biochemistry from Wake Forest in 1958. In 1960 he received a PhD degree in biochemistry from the University of North Carolina and remained there a year as an assistant professor.

LT COL MERLE F. ORMOND has been assigned to the Policy Branch of the Management and Evaluation Division. He was last stationed in Vietnam in successive assignments as chief of the Personnel Services Division, G1, HQ U.S. Army Vietnam, and as executive officer, 1st Infantry Division Artillery.

He was commanding officer of the 5th Battalion, 32d Artillery, Fort Riley, Kans. (1964-65), following duty in the Pentagon with the Materiel Requirements Division, Assistant Chief of Staff for Force Development, and with the Air Defense and Special Weapons Directorate, Office of the Deputy Chief of Staff for Operations.

Col Ormond holds a BA degree in mathematics from the University of Iowa and is a graduate of the Command and General Staff College (C&GSC).

LT COL FRANK L. TAYLOR, new chief of the Management Branch, Management and Evaluation Division, has returned to OCRD from Korea, where he commanded the 2d Squadron, 10th Cavalry, 7th Infantry Division from August 1966 to September 1967.

From 1963-66, he was with the Army Research Office in successive assignments as staff officer, Human Factors and Operations Research Division; chief of the Research Programs Office; and executive officer to the Director of Army Research. He was in Germany (1959-62) as Regimental S3 of the 14th Armored Cavalry.

A 1947 graduate of the U.S. Military Academy (USMA), Col Taylor also holds an MS degree in mechanical engineering from the Georgia Institute of Technology (1956). He has attended the C&GSC.

MAJ DANIEL E. DUGGAN brings to the Plans Division, Nike-X Systems Office, recent experience in Army missilery. His last assignment was as guided missile staff officer with the Eighth Army Support Command, Korea.

Maj D. E. Duggan

Maj G. D. Iverson V

Allen W. Rehrig

Morton H. Marks

From 1961-65, he was at the White Sands Missile Range, N. Mex., in successive assignments as liaison officer, Nike System Project; and chief of the Antitank Test Branch. He served in Okinawa as commander of the 96th Ordnance Detachment, September 1958 to April 1961.

Maj Duggan holds a BBA degree in business from the University of Oklahoma (1955) and has attended the C&GSC.

MAJ GEORGE D. IVERSON V, newly assigned to the Combat Support Aircraft Branch of the Air Mobility Division, last served as a plans officer with HQ 34th General Support Group in Southeast Asia (1966-67).

Previous assignments included aerospace engineer, HQ U.S. Army Materiel Command (1964-66), Washington, D.C., and maintenance officer, 7th Aviation Battalion, Korea, 1963-64.

A 1957 graduate of the USMA, Maj Iverson holds an MS degree in aerospace engineering from Virginia Polytechnic Institute (1962).

ALLEN W. REHRIG comes to the Nike X System Office as a general engineer with several years experience with the U.S. Army Materiel Command (AMC) and the National Aeronautics and Space Administration (NASA).

He was with the AMC (1964-67) as a production engineer and international planner on the U.S./Italy M113 coproduction program and on the U.S./FRG MBT-70 program. His NASA work was as an aerospace technologist on the Saturn I Launch Vehicles (1962-64). From 1952-62, he managed surface-to-surface missile procurement and production activities in the Industrial Division, Office of the Chief of Ordnance. He is a 1949 graduate of Lehigh Univ. in industrial engineering.

MORTON H. MARKS has filled the vacancy of chief of the Systems Research and Engineering Branch, Scientific and Technical Information Division, following promotion of Martin H. Weik to succeed Peppino N. Vlannes as deputy division chief.

Marks had served since December 1966 as technical adviser to the head of the Computer Systems Directorate, U.S. Army Information and Data Systems Command at Fort Myer, Va. Prior to that he was for two years manager of the Business Systems Applications Group and later senior representative of U.S. Army Programs, Federal Systems Operations Department, General Electric Co.

A 1957 engineering graduate of the U.S. Naval Academy, he has studied aeronautics and astronautics at the Massachusetts Institute of Technology and is studying management at the American University.

Other assignments have included data automation monitor for the design of the Command and Control System, HQ U.S. Air Force, Europe, and project officer for equipment acquisition and execution of the U.S. Air Force Standard Base Supply System, Directorate of Data Automation, HQ U.S. Air Force, Washington, D.C.

Dr. Baldes Accepts New Post Challenge at 69

Accepting the challenge of a difficult key assignment after age 65, the retirement dream goal of most federal employes, calls for uncommon fortitude, let alone enthusiasm, but Dr. Edward J. Baldes has both.

With his 70th birthday only seven months away, he departed the security of his U.S. Army Research Office position, which he has held since 1963, to step into a newly created GS-16 position Nov. 27 as U.S. Army Aeromedical Research Unit scientific adviser at Fort Rucker, Ala.

Dr. Baldes was associated for 40 years with the Mayo Clinic, Rochester, Minn., before he became a staff member in the Scientific Analysis Branch, Life Sciences Division, Army Research Office, Office of the Chief of Research and Development. His most recent position with the clinic was senior consultant, section of biophysics, 1959 to 1963. Before that he was director, Division of Physical and Biophysical Research.

In addition to his clinical duties, he was a professor of biophysics at the Mayo Foundation for Medical Education and Research, Graduate School, University of Minnesota, and vice chairman of the Mayo Aeromedical Unit.

From 1942 to 1949, he served as a special civilian consultant to the Aeromedical Laboratory, Wright-Patterson Air Force Base. He has served on the Advisory Panel on Science and Technology to the Committee on Science and Astronautics, House of Representatives, U.S. Congress; the Aerospace Medical Panel, and the Advisory Group for Aeronautical Research and Development of the North Atlantic Treaty Organization.

For his design of special centrifugal devices which contributed to the safety of American aviators in World War II, he was awarded the War Department Commendation for Exceptional Civilian Service in 1945 and the Presidential Citation in 1948. He has also received the French Legion of Honor (1951) and an honorary LLD degree from the University of Saskatchewan (1955).

Dr. Edward J. Baldes

A 1918 graduate of the University of Saskatchewan, Dr. Baldes holds MA and PhD degrees in physics from Harvard University (1920 and 1924), and a PhD degree in physiology from University College, London, England (1936).

He has written more than 150 scientific papers in the fields of biophysics, physiology and aviation medicine and is an active member of many scientific societies.

The U.S. Army Aeromedical Research Unit, commanded by Lt Col Robert W. Bailey, conducts research in all fields of aviation medicine and the aeromedical aspects of biophysics, physiological optics, experimental psychology and aviation physiology.

In addition to studying problems of vision, hearing and the toxicity physiology changes associated with high altitudes and free fall, USAARU research is concerned with problems of medical evacuation of personnel in combat zones.

ASAP Executive Secretary Lt Col Joseph E. Fix III swears in new members during fall meeting of the Army Scientific Advisory Panel at the U.S. Army Aviation Materiel Laboratories, Fort Eustis, Va. Dr. Charles M. Kimball (center) is president of the Midwest Research Institute, Kansas City. Dr. Vincent S. Haneman Jr. is director of Engineering Research at Oklahoma State University.

Army Chiefs Oppose Bill to Shift Civil Works Program

Secretary of the Army Stanley R. Resor, speaking for the Department of Defense, and Army Chief of Staff General Harold K. Johnson voiced opposition at a Senate hearing on legislation that would transfer the Army Corps of Engineers civil works program to the Department of the Interior. The 143-year-old program is funded at about $1 billion annually.

In connection with Senate Bill 886, introduced by Senator Frank E. Moss (D-Utah), the top Army officials presented their statements recently before the Senate Subcommittee on Executive Reorganization, Committee on Government Operations.

The bill would place within the Department of Interior programs and activities of several federal agencies and departments, and would redesignate the Interior Department as the Department of Natural Resources.

Commenting on the bill's goal to coordinate more closely the programs involving natural resources within the Executive Branch and with local and state agencies. Secretary Resor stated that more consolidated management of U.S. natural resources "is a desirable end."

He then raised the question of whether the removing of the civil works program from the Army Corps of Engineers would contribute to the objective. Even if it did, he said, would "that contribution be worth the sacrifice of the benefits, National Security and others, inherent in the present arrangement?

"When it began in 1824," he continued, "the civil works program was aimed only at improving navigability of the nation's rivers, and over the intervening 143 years many functions have been added by Congress: flood protection, development of water power, provision of municipal and industrial water supplies, shore protection, pollution abatement, enhancement of fish and wildlife resources, recreational development, assistance to state and local governments in managing floodplain lands; and assistance to communities stricken by floods, earthquakes and other disasters."

Secretary Resor cited the 1955 study of the second Hoover Commission on the civil works role of the Army Corps of Engineers which not only praised highly its efficiency but recommended that civil works responsibilities should be increased.

"There is substantial reason to doubt," he said "that the performance or coordination of a new agency entrusted with civil works responsibility would be significantly better, and in weighing any possible benefits, one must realize that removal of civil works activities from the Army will also eliminate considerable economies in incidental benefits which have accrued both to the civil works program and to the Department of Defense over the years."

Two interrelated programs are carried by the Corps of Engineers, Mr. Resor advised the Subcommittee: one for military construction, which has aggregated $11.5 billion in the past decade, and the civil works program involving $10.7 billion in the same period.

Throughout the country, he said, military construction activities of the Corps of Engineers, including the important work it does for the U.S. Air Force and the National Aeronautics and Space Administration (NASA), are carried out through the same Engineer District and Division offices that are responsible for the civil works program.

"This conjunction of responsibilities permits the two programs to run on a complementary basis," he explained, "with one overhead of technical and administrative personnel rather than two."

Military construction requirements would demand that a substantial part of this organization continue even if civil works responsibilities were eliminated, he said. In such a case, many of the same jobs and functions which now use one set of employes and one organization would have to be duplicated.

Secretary Resor told the Senate group that with the present dual aspect of the CE program and the complementary nature of its two parts, it is possible to shift personnel quickly and smoothly between them.

In time of war, he pointed out, the magnitude of the civil works program grows. The shift of personnel and funds is in the other direction in time of peace.

"Enactment of S. 886 in its present form could adversely affect the military capability of the Army," the secretary stated. "In part, the success of the Army Engineers in the military field may be credited to the fact that the Corps has also been (for 143 years) responsible for the civil works program."

He said this trained organization has proven itself capable of taking immediate action of inestimable value in military as well as natural disaster emergencies.

He quoted the 1965 report of the Army's Civil Works Study Board, which concluded that conduct of the civil works program "strengthens the Army's competence to support national objectives in wartime by sustaining a broadly based engineering organization-in-being," and that participation in the civil works program "does much to develop in Engineer officers a breadth of vision and capability to take on and discharge the mission requirements of military engineering during mobilization and combat."

In a brief statement following Secretary Resor's remarks to the Senate subcommittee, General Johnson said he believed transfer of the civil works functions of the Army Engineers "would be detrimental to the national interest."

He termed the Engineer Corps an

Engineers Query Shippers on Canal

Representatives of some 150 shipping interests in the United States and other countries using the Panama Canal have been invited to share in preparation of a U.S. Army Corps of Engineers engineering feasibility report on a larger alternative canal.

Col R. P. Tabb, district engineer of the Corps of Engineers in Jacksonville, Fla., has responsibility for preparing the report and he has sent out letters requesting viewpoints. His letter states:

"When a sea-level canal is excavated, it will be designed to serve the world's deep-draft shippers for many years in the future. We are therefore attempting to get ideas from the shipping industry as to what specific needs they have and what their own projections may be for future shipping needs . . . . "

The 42-mile-long Panama Canal has limitations imposed by the 1,000-foot-long, 110-foot-wide and 40-foot-deep locks. This prevents passage of many of the larger ocean-going vessels. A 3-mile section of 300-foot channel presently is being widened to 500 feet.

Specific questions in the letter ask the shippers to give their views relating to ship clearance requirements for the largest ships now under construction or planned in the future. Viewpoints also are invited on maximum safe speeds within a sea-level canal with 2-way traffic, which is advocated as a time-saving improvement.

Opinions also are welcomed on the effect of tidal currents on maneuverability of large ships, and the depth of the proposed new canal in relation to the shippers' projections of future ship sizes.

The letter also queries shippers regarding the need for pilots in a tidal sea-level canal, and the special characteristics projected for ships of the future. Effect of the 5- to 21-foot side tidal range on a sea-level canal and currents caused by the flow of fresh water into the canal also are discussed in the letter, along with probable means of alleviating or reducing tidal velocities.

Col Tabb also serves as chairman of the Canal Studies Coordinating Committee. Shippers are asked to submit information to the Jacksonville district Corps of Engineers office within 30 days for inclusion in the final engineering report on the canal.

The May 1967 edition of the *Army R&D Newsmagazine* carried a feature article on page 8 on the current feasibility study of proposed routes.

essential part of our modern Army and spoke strongly about the vital role the Corps has as a member of the military team. He said the total Army Engineer capability in the U.S. is divided roughly into 75 percent civil and 25 percent military activities.

The Chief of Staff cited several cases of Corps of Engineers' availability in constructing defense sites such as those for the Intercontinental Ballistic Missile and reactivation training bases needed for the Vietnam buildup. It was available to construct support facilities for NASA.

He said the Corps will be available to build sites for antiballistic missile systems and will be ready to support a national Civil Defense effort should this country ever be attacked.

One of his observations was that 75 percent of the Engineers commanding battalions and larger units today in Vietnam have had the benefit of experience gained in Engineer District assignments; 62 percent of Regular Army field grade officers have been similarly trained.

He also said that the civil works program within the Army:

- Provides close ties with the engineering profession and the construction industries, keeping the military up to date on civilian engineering construction, and scientific techniques and developments.
- Provides for an easier flow of the results of military engineering research and development techniques and developments to civilian use.
- Provides tangible and visible evidence at the country's grassroots level of the Army's concern with and participation in the peace-time progress of the nation.

"I am pleased to note," the general said, "that the drafters of S. 886 recognize that the civil works part of the Army Engineers must be available to the Army in time of emergency. But I believe that those capabilities must be available to the Army at all times and particularly during the critical mobilization phase before an actual state of emergency is reached.

"Time available to respond to emergency conditions is now more compressed than ever," he reminded the Senators. "Difficulties and delays inherent to the retransfer of a separate civilian agency would so increase the time required to put the necessary engineering and construction resources into an effective operation that its usefulness in the mobilization phase would be seriously impaired."

He added that there is no assurance that the civil works elements lost to the Army would remain in an organizational form in the new department that would be suitable for military needs when it was transferred.

General Johnson concluded that if civil works responsibilities were taken from the Army, "Our cost of construction would go up, the technical quality of our personnel and the capability of our Army units would be reduced, and our Engineer mobilization base will be impaired and the country will lose that team which responds to *natural* disasters and stands ready to respond similarly to a *national* disaster."

Technical Cooperation Panel Plans 'Operation Prairie Flat'

Nuclear scientists and technicians representing the United States, Canada, Australia and the United Kingdom convened at Aberdeen (Md.) Proving Ground (APG) for the ninth session of Panel N-2 of the Technical Cooperation Program (TCP).

Cooperative research efforts in the blast and thermal areas were discussed and results of the 1966-67 blast test series, "Operation Distant Plain," were reviewed.

Detailed planning was accomplished for "Operation Prairie Flat," a 500-ton high explosive blast simulation test scheduled in Canada in August 1968.

Personnel from selected research laboratories of the Army, Navy, and Air Force, as well as from several contract research organizations, represented the United States at the panel discussions. Julius J. Meszaros, Ballistic Research Laboratories, Aberdeen Proving Ground, Md., is U.S. Army member of Panel N-2.

Laser Rangefinder Aids Coast Guard Iceberg Research

A laser rangefinder is taking the place of optical rangefinders and navigational sextants aboard the U.S. Coast Guard cutter *Evergreen* in research to map iceberg deterioration and drift in the North Atlantic.

Designed primarily for use on dry land, the portable laser was developed by the U.S. Army Electronics Command (ECOM), Fort Monmouth, N.J., and is being used for the first time in the International Ice Patrol research.

First step in the research is to choose a likely iceberg free of impeding field ice and in water deep enough to keep it from grounding. A buoy is moored in the direction of drift as a reference point and drogues set to measure the flow of current.

Meantime, the cutter circles the mass of ice, day and night, as the Coast Guardsmen play the bright laser beam on the looming target to obtain detailed maps of the changes that take place as the iceberg deteriorates.

Technical assistance for using the laser under the special seagoing conditions is being provided by the Electro-Optics Technical Area (EOTA), Combat Surveillance Night-Vision and Target-Acquisition Laboratories at ECOM. Dr. Harrison J. Merrill, chief of the EOTA, is directing studies of the performance of the laser.

STRATCOM — Europe Names Eggert Chief Engineer

Jack H. Eggert, one of the U.S. Government's most highly decorated employes, is the new chief engineer of the U.S. Army Strategic Communications Command headquartered at Heidelberg, Germany.

Formally retired in 1963 but recalled for the Vietnam War, Eggert is a recipient of the Medal of Freedom, two Exceptional Civilian Service Awards, several Meritorious Civilian Service Awards, a Superior Accomplishment Award, and more than 100 letters of commendation and appreciation.

In his new position, he also will serve as special assistant for Communications-Electronics to Brig Gen John B. Kelsey, CG of STRATCOM-Europe. He recently completed a 16-month tour of duty in Southeast Asia as chief engineer of STRATCOM's 1st Signal Brigade and special assistant to the brigade commander.

Eggert entered Civil Service in 1940 and served until he retired at Fort Monmouth, N.J., rising to chief of the Mobile Communications Branch at the Signal R&D Laboratory, forerunner to the U.S. Army Communications Command. He played a key role in the installation of ground communications systems for early U.S. atomic tests in the Pacific.

Jack H. Eggert

During his recent assignment in Vietnam, he earned numerous military citations for his contributions in "expediting completion of major communications projects."

Earlier this year, he was lauded by General Robert Terry for his "conspicuous gallantry and unselfish heroism beyond the call of duty" in restoring a power system at Qui Nhon in Vietnam. In recommending him for an Exceptional Civilian Service Award, General Terry wrote:

"Despite the fact that two dead Viet Cong were found on the causeway and the threat of possible booby-trapped equipment faced him, Mr. Eggert calmly proceeded to correct the fault of failure, thereby reactivating a vital power facility."

Eggert is an honorary member of STRATCOM's 2d Signal Group in Southeast Asia and of the French Signal Corps for service in World War II.

Terrain Analysis for Milit

By WARREN E. GRABAU C
U.S. Army Waterways Exp

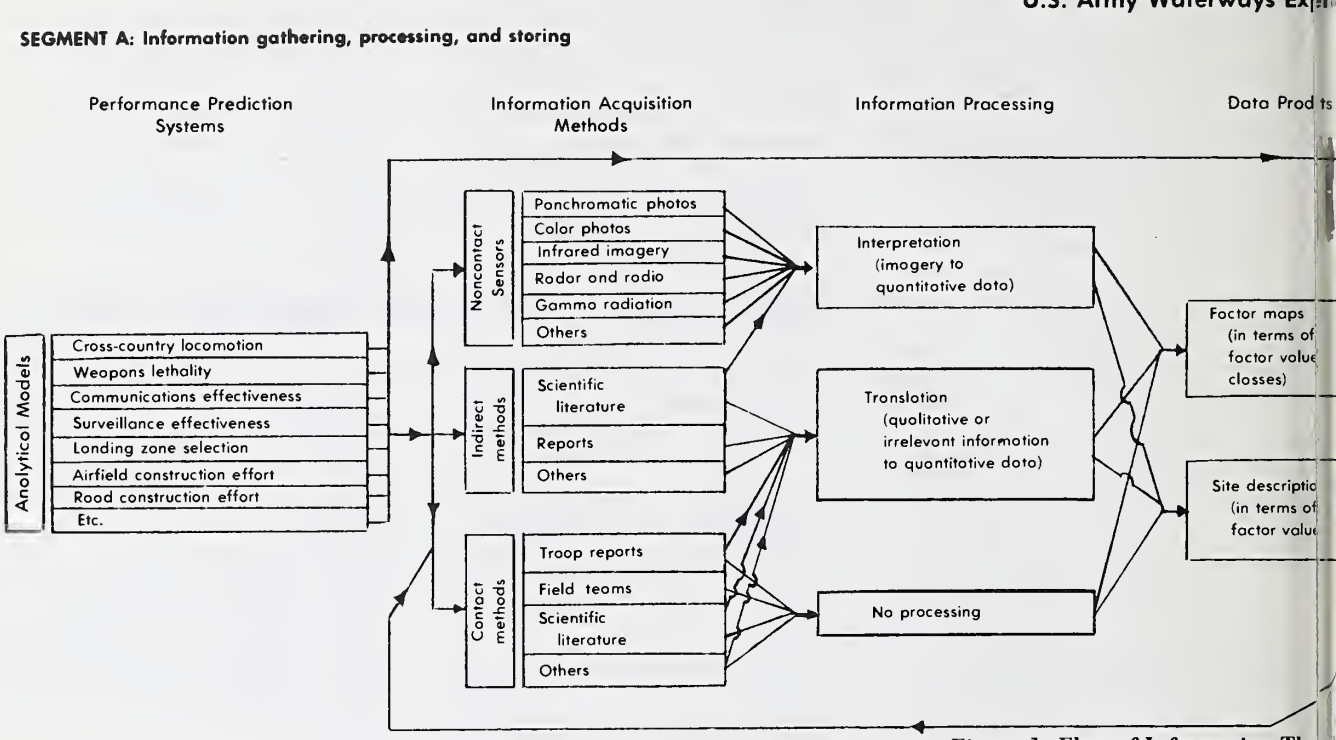


Figure 1. Flow of Information Thr

NOTE: This is the fifth of a series of articles started in the July-August edition on the Army Corps of Engineers broad research and development activities.

There is a widely held opinion that any description or classification of terrain constitutes a terrain evaluation or terrain analysis. This is true in only the most limited sense, even when the terms of description or classification are obviously chosen with reference to military activities.

A statement that a specific region is "characterized by rolling hills and sparse vegetation, making it suitable for armored operations" is of course an evaluation of that terrain. However, such a qualitative generalization is scarcely of use to a modern commander whose tactics and strategy are dependent upon movements and timing no less demanding than those of a ballet.

The function of military terrain analysis is to provide the planner or tactician with such precise information about the terrain that he can calculate its effects on his forces, and on those of the enemy, with reasonable reliability. With such calculations, the commander can make his tactical or strategic decisions with confidence that the terrain itself will not confront him with a devastating surprise.

A prerequisite of the terrain evaluation system is a set of analytical or mathematical models (Col. 1, Fig. 1) relating terrain to the activity in such a way that the performance of any given activity can be predicted in any given terrain context. Such performance prediction models must yield accurate estimates to be useful.

A commander of armored personnel carriers must be able to predict accurately the speed of his vehicles along a specified line of advance if he is to maintain a realistic schedule; this presupposes a quite sophisticated cross-country locomotion model.

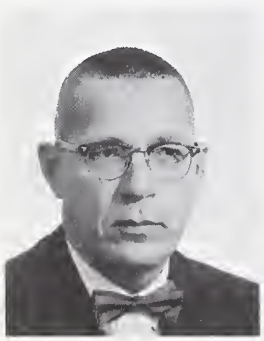
The engineer team must be able to predict how long a given airfield or road construction task will require; the logistics troop commander must be able to select his landing zones with great speed and reliability; and so on.

Finally, the strategists who planned the operation must have taken the effects of the terrain on all of the related activities into account in order to develop a realistic operational plan.

At the present time, a usefully reliable mathematical model for predicting the cross-country locomotion of military vehicles is available. Relatively crude but nonetheless useful analytical models for predicting the effort required to construct military roads and airfields are also in being. Models relating to other military activities also are under development.

The process of developing performance prediction models also results in the isolation of the terrain factors that affect each activity. For example, the airfield construction effort model[1] requires values for four directly measurable factors:

- Characteristic slope, which is the most common topographic slope occurring in the area.
- Soil workability, which is an index of the relative ease with which the soils



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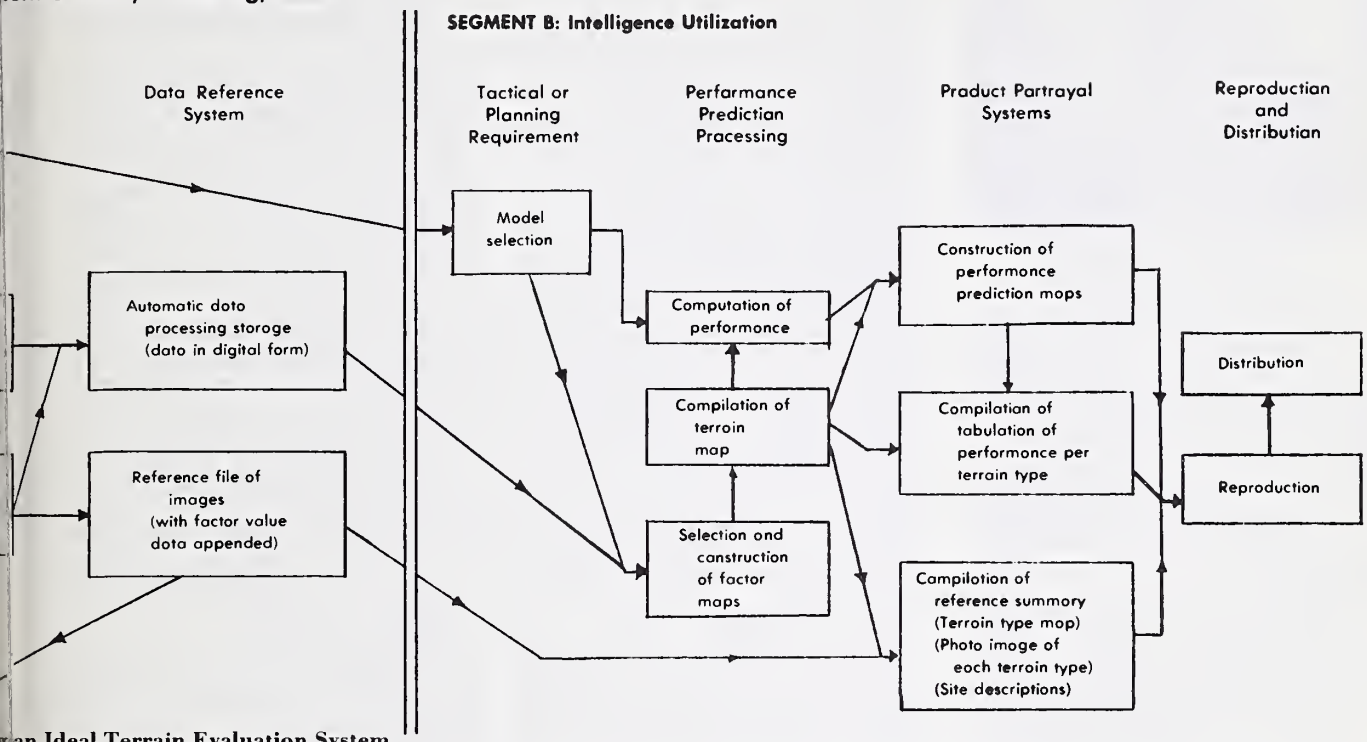

an Ideal Terrain Evaluation System

can be handled with normal construction equipment.

- Depth of soil, which is the vertical distance from surface of the ground to bedrock.
- Mean basal area of plants per unit area, which is a measure of the difficulty of cutting and removing vegetation.

With the significant terrain factors isolated, the terrain analyst is then faced with the problem of acquiring data on them. The information acquisition methods (Col. 2, Fig. 1) which are employed must ultimately yield quantitative data, as required by the analytical models.

Unfortunately, most information furnished up to the present time has been largely qualitative information. Terrain evaluation research must therefore develop information acquisition systems, as well as procedures, for either interpreting or translating (Col. 3, Fig. 1) the output of such systems into the quantitative formats required by the models.

There are three general classes of information acquisition systems, each with its specific sphere of utility:

- The noncontact sensor systems are devices which yield either an image of the terrain or a machine-recorded value of some emission from the terrain. Examples include panchromatic photography, infrared imagery, gamma radiation level, magnetic field properties, and so on.

The major difficulty is that these systems rarely yield quantitative factor data, as required by the analytical models. For example, a stereopair of panchromatic air photos may contain all of the information required to provide data on topographic slope, but the data are not directly obtainable. Therefore, an interpretation process is required to extract them from the imagery.

Unfortunately, much of the previous work on sensor interpretation has been geared to the qualitative information requirements of geologists, pedologists, botanists, etc., and the products of their research are not directly relevant to the needs of the military analyst.

- The contact methods are procedures for the direct measurement of factor values in the field. For example, field teams can visit sites of interest and obtain direct measurements of the significant properties,[5] such as topographic slope, thickness of soil, and so on.

Some scientific literature contains appropriately measured terrain data and therefore qualifies as a "contact" method.

Troop reports could presumably be used, especially if the troops were trained to obtain the specific data required. For the most part, data obtained by contact methods can be used without significant processing (as indicated by Fig. 1), if they have been acquired in the format required by the models.

However, not all information acquired by contact means is usable. For example, a team of agronomists will normally collect data relevant to their scientific discipline, and while these data often contain information of interest to the military analyst, they must normally be translated (Col. 3, Fig. 1) from an agronomy-oriented to a military terrain-evaluation format.

- Finally, in the absence of all other data sources indirect methods of acquiring terrain data can be employed. On the assumption that two areas characterized by the same geological history, climate, and cultural exploitation will strongly resemble each other, the general terrain characteristics of an "unknown" area can be predicted within certain limits by comparing it to some known area with similar background. The resulting terrain descriptions will be statistical at best.

Of the three information acquisition methods, the contact method is by far the most reliable, chiefly because it yields directly usable quantitative measures of significant factors. The major disadvantage is that it provides only site descriptions; mapping any large area by this method is prohibitively costly. The interpretation of noncontact sensor outputs is significantly less reliable, even in areas where adequate ground control (i.e., measurement of factor values in selected sites by contact methods) is available.

Reliability decays rapidly as ground control points become more sparse. The most impressive advantage of noncontact

(Continued on page 20)

Terrain Analysis for Military Geographic Intelligence

(Continued from page 19)

methods is the speed and ease by which large areas can be studied. By far the least reliable of the three data acquisition methods is the indirect procedure; even at best, when supported by adequate topographic maps and literature sources, it provides only statistical terrain descriptions and a data store less reliable than photo interpretation.

To be of use, the acquired data must be recorded and displayed in easily usable forms. The most convenient methods of recording the planimetric distributions of these data appears to be the factor map (Col. 4, Fig. 1).

In this mapping procedure, the total range of factor value of each factor is subdivided into convenient classes, with the class ranges selected in such a way that the errors introduced by using the class ranges as input into the relevant mathematical models are small enough to be acceptable. The various factors are mapped independently. Factor maps have been produced and used in practical exercises.[1,6]

An ideal terrain evaluation system should also preserve for future reference the interpretation and translation rationales. Two steps are involved: the establishment of uniform contact data acquisition procedures, and the recording of interpretation rationale for acquiring data from sensor imagery.

Research is continuing on a standardized contact data acquisition system. The process is simple and direct; the field team visits the site, takes a prescribed set of measurements and records the data on forms designed to be readily transcribed into ADP storage (Cols. 4 and 5, Fig. 1).

The United Kingdom has developed a workable system for recording interpretation rationales.[2,7] Basically, the U.K. system envisions a store of both qualitative and quantitative site data, supplemented by appropriate noncontact imagery which is annotated in such a way that future interpreters will find it easy to follow the logic used in interpretation. The system depends upon the availability of imagery for successful application.

Because of the complexity of the terrain evaluation system being hypothesized, and because of the enormous amount of data which will have to be handled, it is apparent that an ADP system for storing and retrieving the data at any desired time will be required.

To this end, machines and ADP programs are being developed for converting the factor maps into digital form on magnetic tape.[3] With these devices, any desired factor map could presumably be reconstructed at will with an automatic plotter. The problem of recovering imagery and interpretation rationale by ADP has not been systematically investigated.

The file of factor maps constitutes only a description of the terrain, not an evaluation of it. As an example of the operation of the evaluation process (Segment B, Fig. 1), let it be assumed that a planner is concerned with an operation involving the construction of airfields in some specific geographic region.

The planner first identifies the pertinent performance prediction model (Col. construction effort model. The input requirements of the model specify the factors required: characteristic slope, soil workability, soil depth, and mean basal area of vegetation.

The maps displaying these factors would then be withdrawn from machine storage and constructed with an automatic plotter at some convenient scale (Col. 7, Fig. 1). A more convenient presentation can be achieved by compiling the four factor maps into a map showing types of terrain (Col. 7, Fig. 1).

It must be emphasized that a terrain type is *not* a landform (except by coincidence); a landform such as a cuesta may be subdivided into a number of terrain types on the basis of differences of slope, vegetation, soil depth, and so on.

At the present time, factor system terrain-type maps have been compiled by hand.[4] This is at best an inordinately costly process. However, a computer program for accomplishing this process has been written and is nearly ready for utilization.[3]

The next steps in the evaluation process consist of identifying each terrain type, extracting the factor values which characterize each, and inserting each combination successively into the performance prediction model.

The products of these computations (Col. 7, Fig. 1) can then be placed on the map in the appropriate map units (i.e., in the chosen example, a construction effort number is substituted for the equivalent terrain type number). The user now has a map displaying the average number of days required to build an airfield of the specified type at all points in the area of interest (Col. 8, Fig. 1).

Since each construction effort level (or value) is delineated as a map unit on the final map, the areas of each can be readily measured or calculated, and the results easily compiled into a tabulation showing the total range of construction times that could be expected in the theater, the proportion of total areas exhibiting various levels of required construction effort, and so on (Col. 8, Fig. 1)

Even this may not be enough. A situation can be imagined in which the time required for a standard Engineer construction battalion to construct the needed airfields would be tactically unacceptable, but in which a specially constituted force of equivalent size might accomplish the task.

For example, in heavily forested flat terrain, the tree-felling and disposal capability of the work force might be increased at the expense of grading capability. However, before such a decision can logically be made, the nature of the terrain environment must be known in some detail.

Perhaps the most useful information for this purpose would be a compilation of site descriptions and air photo images relevant to the area of interest. Since these will presumably be stored in a readily accessible file (Col. 5, Fig. 1), compilation of these into a reference summary (Col. 8, Fig. 1) would be simple and direct.

Even compilation of all pertinent information does not quite meet the practical needs of the Army; the information must be reproduced in sufficient quantities to be available to all potential users, and it must be distributed to such users in time to be of benefit (Col. 9, Fig. 1).

Thus, a completely integrated and largely automated terrain evaluation system for the Army can be visualized. Further, major modules of the integrated system are in being, albeit still in experimental form, so that the successful operation of the entire system can be confidently anticipated.

The Engineer Topographic Laboratories at Fort Belvoir, Va., are now proceeding to integrate an automated terrain analysis capability into a military geographic intelligence (MGI) systems concept for field army and strategic use. A subsequent article will describe this MGI system and the characteristics necessary to meet the army's requirements for geographic data.

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Receives Master Designer Award

HDL's Chief Scientist Honored for 40 Patents

When Chief Scientist Dr. Henry P. Kalmus of the Harry Diamond Laboratories, Washington, D.C., became one of the 10 recipients of the 1967 Master Designer Award presented Nov. 3 by *Product Engineering* magazine, it was revealed that he has 40 patents, plus three applications pending.

That disclosure may have abruptly terminated the anticipated long run of the unofficial contest of the *Army Research and Development Newsmagazine* to find "The Man with the Mostest" patents among employes of Army R&D installations.

The contest was initated in the September edition with a story from the U.S. Army Electronics Command that Dr. Helmut L. Brueckmann had been granted his 16th patent.

In the November edition, a total of 28 small arms patents was reported by Fred Reed of the Research and Engineering Division, Rock Island (Ill.) Arsenal. However, Earl Harvey of Rock Island had 34 patents when he recently left U.S. Government service.

Four of the 40 patents granted to Dr. Kalmus are classified. The others are documented by title and number, including two awarded before he left his native Austria in 1938 to become a U.S. citizen. His first patent in 1935 was for a superheterodyne receiver and in 1937 he received a British patent for "Improvements Relating to Ganging, etc."

Only three of the inventions credited to Dr. Kalmus involved collaborators - C. W. Carnahan for assistance on No. 2,507, 409, Time Modulated Wave Receiver (May 1950); S. F. Varian for No. 3,024, 456, Composite Instrument (March 1962); and M. L. Libman for No. 3,042,868, Dual Path Remote Control System (July 1962).

Dr. Kalmus was the only Department of Defense employe named by *Product Engineering*, a design engineers publication, to receive the 1967 Master Designer Award. There were 100 nominations in various fields.

The eighth annual PETE (Product Engineering Tribute to Excellence) trophy was presented to Dr. Kalmus at an honorary dinner in Washington by Walter A. Stanbury, *Product Engineering* editor-in-chief.

The award recognized Dr. Kalmus' invention of a radar-type instrument that will enable astronomers and gunners to sort unidirectional targets out of "clutter" or background radio noise caused by randomly moving objects.

The citation also acclaimed a recently patented device which measures gravity against centrigual force, one of the few standards that are the same on earth, the moon and other planets.

Dr. Kalmus received electrical engineering degrees in Vienna and established a reputation in electrical design while working in Austria and Hungary. He applied automatic frequency control to short-wave receivers for the first time and with an ophthalmologist friend developed a way to measure the electrical resistance of the eye for better control of the diathermic method of treating detached retinas.

Dr. Maurice Apstein, associate director of Harry Diamond Labs, who nominated Dr. Kalmus for the Master Designer Award, commented that "for each of his contributions that we can talk about, there are nine others that security forbids mentioning . . . .

"He is the living epitomization of the old standard for good engineering: 'Value for money.' No matter how sophisticated or complicated the problem . . . his decision is always startlingly simple. Very often a Kalmus circuit is so sparing of materials that we find it is really doing two or more jobs."

Among Dr. Kalmus' electrical/electronic achievements are: circuits that are used in most U.S. missile and ordnance systems; the first altimeter capable of measuring altitudes as low as two feet; a photometer that uses a 60-cycles-per-second magnetic field to separate a.c. and d.c. for more precise measurement of light; and a phonograph pickup that revolutionized record-playing in the 1940s (the "Cobra" arm).

This Master Designer Awards program is patterned after the guild system of medieval Europe in which a journeyman candidate had to submit a test piece to the wardens of his guild. Acceptance of his test, or "master" piece, by the wardens signified that the candidate had satisfied the highest standards of workmanship, appearance, function and technique, and had the right to call himself a master.

Thus honored with PETE in 1967 are the career-long contributions and the personal dedication of the 10 engineers and scientists who have become Master Designers in a tradition closely linked with medieval times.

Dr. Kalmus' award was in the Electrical/Electronics Power and Control category, one of eight categories of which only seven could claim a Master Designer. A special award was made this year in Medical Engineering and none was made for Product Planning and Management. Other categories include Research and Technology, Mechanical Design and Power Transmissions, Fluid Power and Control, The Engineer and His Profession, and Manufacturing and Materials. Eight executives of private scientific and engineering industry and a Columbia University professor were judges. Each recipient of PETE was honored separately.

Other winners are Joseph E. Killpatrick of Honeywell, Inc., for the laser gyro, pointing control for sun-seeker and scanner, and for an inside-out horizon scanner; Edward J. Wellauer, Falk Corp., for various gearing systems and materials development and for professional activities in standards making and other fields; and

Dr. Henry P. Kalmus

Russell W. Henke, Milwaukee School of Engineering, for fluid power system and component designs and for educational activities in the fluid power field; Morris Asimow, University of California (Los Angeles), for development of new methods of engineering education, application of American business, technical and distribution to undeveloped areas in the U.S. and abroad; and

Myron Tribus and Robert C. Dean Jr., Thayer Engineering School, for engineering education methods stressing design training; Melvin M. Seeloff, Taylor-Winfield Corp., for developing manufacturing machinery for metals production, and air valve using O-rings as valving elements; and

Clarence G. Pieber, International Nickel Co., Inc., for developing and processing high- and low-nickel alloys; and Frank L. Rose of Becton, Dickinson and Co., for developing an artificial kidney which a patient can use at home.

Eglin Gives Pershing Missile Temperature Shock Tests

The Army's Pershing 1-A missile system is undergoing a 90-day series of operating tests at temperatures ranging from about -55° F. to more than 150° F. in climatic test chambers at Eglin Air Force Base, Fla.

Scheduled for completion in February, the tests also will include prolonged exposure to rain, snow, ice and high humidity with a series of rapid changes to induce temperature shock.

The test team is composed of missile engineers and technicians from the Army's Pershing Project Office at the U.S. Army Missile Command, Redstone Arsenal, Ala.; General Purpose Vehicle Project Office, U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Md.; and the Martin Marietta and Ford companies.

RDT&E, Procurement Contracts Total $548,450,327

Army contracts exceeding $1 million each for research, development, test, evaluation and procurement awarded from Oct. 11 to Nov. 10 totaled $548,450,327.

Martin Marietta Corp. received a $52,000,000 contract for FY 1968 Pershing missile ground support equipment and a $10,351,000 contract for continued services in support of the Pershing system.

Hercules, Inc., was awarded two contract modifications totaling $54,240,892 for manufacture of propellants and for operations and maintenance activities.

Three contracts with Olin-Mathieson Chemical Corp. totaling $40,637,111 are for ammunition and auxiliary detonating fuzes. Mason and Hanger - Silas Mason Co., Inc., received modifications totaling $29,403,408 for loading, assembling and packing artillery projectiles, large-caliber ammunition, bombs, mines and related components.

Canadian Commercial Corp. will supply vehicular-mounted radio relay sets, ammunition, nitroguanadine, 5.56mm ball cartridges and tracked vehicles on five contracts totaling $21,601,745. Remington Arms Co. will furnish ammunition for $18,735,339.

John R. Hollingsworth Co. received increments of $3,973,783 to two contracts totaling $14,879,656 for 3-kw. generator sets. General Motors Corp. will supply diesel engines for armored personnel carriers and 20mm guns and gun bodies for use on single-wing aircraft for a total of $14,480,916.

AVCO Corp. received an $11,311,300 modification for turbine engines for the CH-47 helicopter and a $1,487,427 contract for metal parts for 40mm projectiles. American Machine and Foundry Co. won a $12,728,624 contract for metal parts for 750-pound bombs. The United Aircraft Corp. was awarded contracts totaling $11,630,000 for engines, materials and components for CH-54A helicopters.

Boeing Co. was awarded an $11,000,000 contract for FY 1969 prebuy of sets of long-lead-time items for CH-47C helicopters. Hesse-Eastern Division of Norris Industries Corp. will supply 66mm rocket launchers on a $10,890,356 contract definitization. International Telephone and Telegraph Corp. and Varo, Inc., each received an initial increment of $4,000,000 on $11,000,000 contracts for assembly of 25mm image intensifiers.

Southwest Truck Body Co. will produce semitrailer-mounted shop sets for $7,425,354. National Presto Industries, Inc., was issued a $7,000,000 modification for metal parts for 8-inch projectiles and Levinson Steel Co. received a $6,604,500 contract for metal parts for 105mm projectiles.

Mack Trucks will supply 10-ton tractor trucks for $6,500,000 and Donovan Construction Co. received a $6,400,000 modification for metal parts for 155mm projectiles. Metal parts for 20mm projectiles will be furnished by the Amron Corp. for $5,976,000. The Hupp Corp. will provide 10- and 20-horsepower gasoline engines on a $5,148,480 modification.

Radio Corp. of America (RCA) received a $3,995,000 contract for a system study to determine and identify the detailed system and subsystem design of the Mallard Communication System. RCA also gained a $1,826,206 contract for panoramic telescopes for 175mm and 8-inch howitzers.

Sylvania Electric Products, Inc., received a $3,500,000 contract for a system study of the Mallard Communications

Arsenal Develops Launcher For Riot Control Chemicals

Operational characteristics of the E8 Expendable Launcher for riot control chemical agents developed recently by Edgewood Arsenal, Md., may be described as versatile, accurate, lightweight and easily man-portable.

Engineered to strap on an infantryman's back, the 34-pound E8 can be fired manually or electrically controlled to launch 64 cartridges to set up a large riot-control agent cloud in approximately 30 seconds.

A simple inclinometer sets the launcher at the desired elevation, ranging from an almost flat trajectory to an angle of 90°. The firing platform consists of three metal plates which are fanned out on the ground, with spikes to hold them in position.

Edgewood Arsenal munitions experts report that when all cartridges have burst on the target, the intense cloud generated would temporarily incapacitate any unmasked personnel in the target area.

Its versatility makes the E8 effective for defensive or offensive operations, particularly in the confined battle regions encountered in Vietnam. The launcher is being manufactured by the Brunswick Corp., Marion, Va.

E8 Expendable Launcher

Edgewood Arsenal Responds Rapidly to Vietnam Need

Four months after an urgent requirement for lightweight, compact, water-resistant, protective masks was levied on Edgewood Arsenal, Md., the first XM28s were delivered to Southeast Asia. This quick response was due to knowledge accumulated in earlier materials research.

Arsenal engineers recognized the value of silicone rubber and polycarbonate eye lenses to give the mask the required "foldability" and the capability to function after submersion in water and lengthy exposure to dampness and high humidity.

A modified outlet valve, rubber chinstrap, nosecup, eye lenses, and nosecup stiffener were designed. Prototypes were constructed and new techniques were developed to fabricate the internal components.

Joint action resulted in a model example of "concurrency," in which the various phases of research, development, testing, engineering, and production were accomplished simultaneously in four months, rather than in chronological sequence.

Laboratory and field tests considered requirements for climatic compatibility, human factors, mold design and fabrication, and materials serviceability.

Key features include a nosecup molded from the same silicone material as the facepiece, allowing air to enter the mouth and nose area and preventing exhaled air from reaching the inner surfaces of the lenses to cause fogging.

A rubber chinstrap aligns the mask correctly and relieves tension or "pull" on the forehead.

Any soldier familiar with the standard M17 mask can don and operate the XM28 mask after a short explanation and demonstration.

XM28 Protective Mask

System, as well as contracts totaling $5,787,756 for electronics research and development. Cessna Aircraft Co. will provide bomb dispensers on a $5,453,214 modification.

Contracts totaling $5,033,830 with Zeller Corp. for 20mm cartridge fuzes and metal parts for 20mm projectiles. Honeywell, Inc., will provide metal parts for bomb-nose fuzes and grenade fuzes for $4,788,480 and Bell Helicopter Co. will supply rotary rudder blades and gear box assemblies for UH-1 helicopters for $4,445,527.

Delaware Valley Armaments, Inc., won a $4,252,200 contract for metal parts for artillery round boosters. Multiplexers were ordered from the Raytheon Corp. on a $3,811,150 modification. The Chamberlain Manufacturing Co. will provide 105mm projectiles for $3,796,023. Galion Amco, Inc., was awarded a $3,517,200 contract for 20mm cartridge fuzes.

Federal Cartridge Corp. received a $3,476,935 contract for 5.56mm ball cartridges in 10-round clips. Philco-Ford Corp. will provide components for the Chaparral guided missile system for $1,800,000 and guided missile system test sets for $1,451,200.

ETOWAH Manufacturing Co., Inc., was issued a $3,149,525 contract for metal parts for artillery round boosters. Dorsey Trailers, Inc., received a $3,038,665 contract for semitrailers. Kennedy Van Saun Corp. will supply metal parts for 4.2-inch projectiles for $3,007,620.

Sperry Rand Corp. will receive $3,000,000 for electronics equipment and Theurer, Inc., was awarded a $2,794,122 contract for M750 semitrailers. Supreme Products Corp. will supply 20mm cartridge fuzes for $2,747,900 and Lehigh, Inc., was issued a $2,616,804 contract for metal parts for 2.75-inch rocket warheads.

Aerojet General Corp. received a $2,579,200 contract for metal parts for 2.75-inch rockets, General Electric Corp. will supply 20mm air defense artillery guns for $2,540,000 and ammunition boxes will be furnished by Kaiser Steel Corp. for $2,522,000. ACF Industries Inc. will receive $2,507,400 for metal parts for cluster bomb units.

Hayes International Corp. won a $2,460,800 contract for metal parts for rocket warheads. Metal parts for cluster bomb units will be purchased from the Scovill Manufacturing Co. for $2,456,622 and from the Batesville Manufacturing Co. for $2,435,517. Parsons Manufacturing and Stamping Co. received a $2,381,491 definitization to supply projectile parts.

The KDI Corp. will furnish 2.75-inch rocket fuzes for $2,336,480. Consolidated Box, Inc., received a $2,313,600 contract for fiber ammunition containers.

United Ammunition Container Corp. will provide ammunition containers for $2,223,840. Hughes Tool Co. was issued a $2,153,519 delivery order for crew and component armor kits for OH-6A helicopters. Rohm and Haas was awarded a $2,150,000 contract for propellant research.

Electro Mechanical Corp. gained a $2,115,099 modification for electrical equipment shelters, Hayes Albion Corp. was issued a $2,041,600 contract for metal parts for 2.75-inch rocket warheads, and General Time Corp. will furnish metal parts for 2.75-inch rocket fuzes for $2,020,200.

Standard Winding Co. received a $367,362 initial increment to a $1,991,865 contract for work on vehicular radio communication sets. ESB, Inc., will provide primary wet batteries for the Nike Hercules missile for $1,953,153. Emco Porcelain Enamel Co., Inc., will furnish ammunition boxes on a $1,949,000 modification.

Stanford Research Institute received a $1,941,953 modification from the Army Research Office-Durham for classified research. Weatherhead Co. will supply metal parts for 105mm heat projectiles on a $1,869,562 modification and Standard Container Co. was issued a $1,865,500 modification for ammunition boxes.

International Harvester Co. will furnish cargo trucks for $1,851,016 and metal parts for 40mm projectiles will be supplied by the Eastern Tool and Manufacturing Co. for $1,824,320. Eisen Bros., Inc., was awarded a $1,740,182 contract for metal parts for 40mm projectiles and a $1,712,776 contract with Firestone Tire and Rubber Co. is for pneumatic tires for earth movers.

Maremont Corp. received a $1,648,626 modification for machineguns, spare barrels and bipod assemblies, Bulova Watch Co. will furnish metal parts for 2.75-inch rocket fuzes for $1,609,650, and Remington Arms will supply ammunition for $1,598,628. A $1,587,000 definitization for portable low-frequency amplifiers was awarded to Teledyne Industries.

Waltham Precision Instruments, Inc., received a $1,583,818 contract for 20mm cartridge fuzes and Motorola, Inc., will deliver radar surveillance sets on a $1,555,372 definitization.

Other contracts and modifications are: Kaiser Jeep Corp., $1,483,218 for ¼-ton utility trucks; Bermite Powder Co., $1,468,200 for auxiliary detonating fuzes for major caliber projectiles; Iowa Manufacturing Co., $1,447,560 for diesel-engine-driven crushing and screening plants; Airport Machining Corp., $1,420,800 for parts for 2.75-inch rocket warheads; and

LTV Electrosystems, Inc., $1,414,810 for radio receivers and transmitters; Applied Devices Corp., $1,379,085 for Hawk simulator trainers; R. C. Can Co., $1,377,600 for fiber ammunition containers; Beech Aircraft Corp., $1,329,704 for U-21A utility aircraft and related data; Western Electric Co., $1,295,800 for display console kits for modification of the Nike Hercules missile system; Vatronics, Inc., $1,291,400 for time fuzes for aircraft flares; and

Cabot Corp., $1,251,192 for tube forgings for the 152mm M81 gun and the 152mm XM162 gun; M. C. Riccardi Co., $1,249,500 for fiber ammunition containers; Air Logistics Corp., $1,239,064 for 392 sets of assault trackway and applicable parts kits for helicopter landings; Brunswick Corp., $1,223,697 for grommets for 155mm projectiles; and

Brown Engineering Co., Inc., $1,137,027 for an interim data system program for the Nike-X program; Carey-Waterbury Co. and North American Dye Corp., $1,131,016 for colored smoke dye; Westinghouse Electric Corp., $1,060,000 for transportable generator sets; and Flinchbaugh Products, Inc., $1,009,400 for metal parts for 90mm projectiles.

ARTIST'S SKETCH OF SAM-D (Surface-to-Air-Missile Development) was released recently, revealing Army concept of highly mobile, all-weather system. Now in advanced development, SAM-D will simultaneously acquire, identify, track and destroy low-, medium-, and high-flying aircraft and short-range missiles. The SAM-D program is managed by Col Edward Dooley, U.S. Army Missile Command.

"Wait an Atomic Second?"

40-Nation Conference Redefines Second

Expected almost any day now from the avant garde of the young generation is the expression, "Wait an *atomic* second!" — denoting an ultra-precise standard of time adopted recently in Paris by a 40-nation General Conference on Weights and Measures.

As defined for the use of an atomic clock, "the second is the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the fundamental state of the atom of cesium 133." That doesn't throw you slightly, does it?

This approach to precise time is interrelated with continuing U.S. Army research in atomic and molecular frequency control to pinpoint the international unit of time — the second — to the standard needed for fully military tactical time that can be synchronized worldwide.

The new atomic definition replaces the long-used definition based on the earth's orbital motion around the sun.

Although Army scientists at the Fort Monmouth, N.J., Electronics Command (ECOM) have for years been seeking ultra-precise time and frequency control and have succeeded in developing devices to measure time, the new definition of the second provides another base upon which to continue interservice research and exploratory investigations.

Project WOSAC, an interservice experiment directed toward worldwide synchronization of atomic clocks, had its main phase completed in 1960. This was a project to demonstrate the feasibility of clock synchronization to one microsecond, and better, over thousands of miles.

Studies were coordinated with the then U.S. Army Signal R&D Laboratory at Fort Monmouth, the U.S. Air Force Rome (N.Y.) Air Development Center, U.S. Naval Electronics Laboratory and the British Post Office. Harvard Prof. J. A. Pierce also was close to the project.

Atomic clock development proceeded and in 1965 ECOM and the General Technology Corp. developed a 44-pound atomic clock that could measure time down to one 10-billionth of a second.

Every conclusion or incident regarding scientific time, such as the new international definition of the second, contributes to the "growing military need for precise and stable sources," so states Vincent J. Kublin, director of the Solid State and Frequency Control Division of the Electronics Components Laboratory at ECOM.

Principal investigators of the military aspect of ultra-precise time are ECOM's Drs. Helmut Hellwig and Eric Hafner.

Primary objective of the ECOM task is to satisfy the military need of ultra-precise time and frequency control in communications, navigation and surveillance equipment.

The ECOM program includes investigations and theoretical studies on quantum electronic effects and solid-state phenomena to arrive at new and improved frequency and time sources.

ECOM scientists continue investigating the many possible avenues that may lead to "the perfect time unit" that can be synchronized over vast distances.

Today, as for many years in the past, many "time keepers" of the world using atomic clocks and frequency generators continue to calibrate against a standard such as the National Bureau of Standards Frequency Standard, controlled by a cesium atomic beam in Boulder, Colo., at the NBS Radio Standards Laboratory. NBS broadcasts have been monitored by an atomic frequency standard since 1957.

By Department of Defense directive, the time-frequency standard for all U.S. Military Forces, ashore and afloat, is calibrated from the U.S. Naval Observatory in Washington, D.C. Only in emergencies may another source be used.

Until this era of the atom and the many-disciplined explorations by advanced scientists, time had long been measured in terms of earth's rotation.

The scientific unit of time — the second — once was defined as 1/86,400 of a mean solar day. Constant observations, however, showed that the rotation of the earth proved too erratic to meet modern scientific needs for keeping time. Fluctuations are periodic and unpredictable and the mean solar second constantly changes.

Scientists of the world — despite a 1956 redefinition of the second for scientific use as 1/31,556,925.9747 of the tropical year, ephemeris time, 0 January 1900 — are still seeking the ultra-ultra-precise unit.

Director of the National Bureau of Standards Dr. A. V. Astin headed the U.S. delegation to the Paris conference.

Standards Bureau Reports 1967 Research Highlights

Research programs and a comprehensive discussion of the national measurement system are featured in the newly published *1967 Technical Highlights of the National Bureau of Standards.*

The discussion of the measurement system is an attempt to view the increasing complexity of U.S. measurement activities in an orderly fashion and to assure that NBS fulfills its proper role.

The main body of the report deals with significant scientific and technical accomplishments during the fiscal year. Brief mention is made of a variety of studies and experiments. They include:

- An absolute determination of acceleration due to gravity, paralleling similar research at other national labs.
- Current laser research designed to form a basis for a national standard of laser energy.
- Solar radiation measurements to aid the U.S. Public Health Service in air pollution research.
- Tests on automobile braking systems, seat belts and tires for the Transportation Department's Office of Vehicle Systems Research.
- Dissemination of the first sets of weights and measures under a 5-year program to provide each state with new standards.

The 162-page report costs 55 cents when ordered from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. It also may be obtained from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151, or from local U.S. Department of Commerce Field Offices. Foreign remittances must be in U.S. exchange and should include an additional one-fourth of the publication price to cover mailing costs.

BRL Scientists Patent Device

A patent for a device to measure atmospheric vapor was awarded recently to Emmett J. Pybus and Donald G. McCoy of the Ballistics Measurements Laboratory, Ballistic Research Laboratories, Aberdeen Proving Ground, Md. The "A.C. Controlled D.C. Current Amplifier" has been sent into the stratosphere from Thule, Greenland; Fort Churchill, Manitoba, Canada; and the British West Indies.

ADFSC Selects Technical Director From Industrial Ranks

George Sokol

George Sokol was recently appointed technical director for the Automatic Data Field Systems Command (ADFSC), Fort Belvoir, Va.

A Harvard University graduate (BS in physics) and a World War II Navy veteran, he brings to his new duties a record of major assignments in the scientific and electronics fields. For the past 15 years he was engineering manager for Sylvania Electronic Systems and also managed the Computer Development Laboratory.

For the U.S. Army, he managed the MOBIDIC (Mobile Digital Computer) Project and in 1961 and 1962 was attached to Headquarters U.S. Army, Europe on this project.

Prior to his Sylvania employment, Sokol was an electronic scientist at the U.S. Naval Ordnance Laboratory from 1947 to 1951. He participated in Operations Sandstone and Greenhouse at Eniwetok Atoll with the U.S. Joint Task Force.

550 U.S. Scientists Attend IUGG Meet

More than 550 U.S. scientists and nearly 1,600 from other nations received a state-of-the-art review and new stimuli in many scientific disciplines at the recent 2-week 14th General Assembly of the International Union of Geodesy and Geophysics (IUGG) in Switzerland.

Representing the U.S. Army Chief of Research and Development were geophysicist Dr. Valentine E. Zadnik of the Environmental Sciences Division, U.S. Army Research Office (USARO), Arlington, Va., and James Appleby, meteorologist and chief, Environmental Sciences Branch of the U.S. Army R&D Group, Europe, at Frankfort, Germany.

The IUGG General Assembly, which meets quadrennially, elected former vice president Prof. J. Coulomb of the National Center of Special Studies, Paris, France, to succeed president Prof. Joseph Kaplan of the University of California, Los Angeles, for the 4-year term.

Invitations for the 15th General Assembly in 1971 have been received from Russia, India and France. The 1963 assembly was at Berkeley, Calif.

Sessions of the assembly were held concurrently at Zurich, Bern, Lucerne and St. Gall, Switzerland. Dr. Zadnik reported that the technical programs of the seven international associations comprising the IUGG were extensive and related to Army research.

Primary function of the IUGG is to stimulate and cooperatively perform geophysical research on an international scale. It was formed in 1919 in Brussels, Belgium, by the union of six autonomous international associations in geodesy, seismology, meteorology, terrestrial magnetism and electricity, physical oceanography and volcanology. Joining in 1922 was the International Association of Scientific Hydrology.

Many outstanding U.S. scientists who attended the IUGG were supported by grants from the National Academy of Sciences. The Army funds to the NAS travel pool supported 20 scientists at the meetings. Other agencies contributing to this pool included the U.S. Atomic Energy Commission, National Science Foundation, Department of Health Education and Welfare, Environmental Science Service Administration and the National Aeronautical and Space Administration.

Dr. Zadnik further reported, as an example of the IUGG's activities, that among the outstanding topics in seismology was the work based on the Upper Mantle Project, an international IUGG program to study the solid earth through the cooperative efforts of 50 nations, including the U.S.

Welcoming the assembly for the Swiss Academy of Sciences host, Swiss Federal Councillor H. P. Tschudi said that the IUGG rates as one of the most important international scientific organizations.

"It came into the limelight," he said, "with the greatest venture it has so far launched, the International Geophysical Year (IGY). This tremendous undertaking is no doubt the greatest scientific feat ever achieved in common by a great number of countries.

"This fact," he said, "is corroborated in the opinion of specialists . . . that this one year (1957) yielded more knowledge about the earth, the oceans and the atmosphere than the knowledge collected by all the bygone centuries and millenia taken together, since the remote past when man started exploring the earth.

"This reminds us that some of the branches of science represented in your Union have deep roots down in antiquity. Other ventures of similar scope are at present in progress, for instance, the 'Upper Mantle' and the 'Hydrological Decade' projects of which we may expect more precise data on the structures of the earth's crust and on hydrological phenomena."

General Assembly presentations were considered valuable in updating professional knowledge of scientists and to staff members administering or directing U.S. Army research programs in the geophysical sciences.

In his final address as IUGG president, Prof. Kaplan reviewed the past four years' work of the various groups within the organization and praised the advances reported in specific responsibilities.

"We should emerge from this assembly with nearly 70 member nations," he said. "I hope that the next period between General Assemblies will add 10 more nations to our membership."

He said that geophysics has much to offer to all nations, old and new. "The Union brings together, perhaps more than any other Union, both the pure and applied scientists. This has been a great source of strength and interest, and I hope that this meeting of science and technology will be increasingly emphasized in the future."

Standards Bureau Issues Weights, Standards Sets

Within the next few months, 10 of the 50 United States will have received new weights and measures standards, replacing those provided to all states by Congressional authorization in 1838. This is the first new issue in 100 or more years.

The National Bureau of Standards (NBS) is supervising replacement of state standards to update and extend measurement competence throughout the nation as required to meet scientific and technological advances.

Most recent states to receive the new NBS standards sets are Oregon (Oct. 27) and Utah (Oct. 30). NBS Director Allen V. Astin made the ceremonial presentations to Oregon Governor Tom McCall and Utah Governor Calvin L. Rampton.

Ohio was the first state to receive a set last June 8, followed by Illinois the next day. Next on the 10-state-a-year schedule planned by NBS are California, Connecticut, Delaware, Kentucky, New Mexico and Tennessee.

Each new set includes standards of mass (weight), length, and volume and necessary laboratory instruments — including high-precision balances — all designed for weights and measures requirements.

Each set costs the Federal Government $70,000, including calibration, installation and training of laboratory personnel. The states' contribution to the program exceeds the federal expenditure in new or expanded laboratory facilities and better qualified personnel.

Measurement uniformity among the states began in 1838 when Congress authorized the government to supply each state with " . . . a complete set of weights and measures adopted as standards — to the end that a uniform standard of weights and measures may be established throughout the United States."

Actual regulation of weighing and measuring equipment in commerce is retained largely by the states, with the NBS serving as the principal technical resource.

Col Higgins Commands STRATCOM Signal Group in Colorado

Col William A. Higgins is commanding the recently activated U.S. Army Strategic Communications Command Signal Group (Air Defense) at Colorado Springs, Colo., and also will continue to serve with the U.S. Army Air Defense Command as director of Communications-Electronics.

The new group will serve as an arm of ARADCOM, a major division of the North American Air Defense Command (NORAD), along with eight other communications subcommands headquartered in Vietnam, Europe, South America, the Pacific area and Continental United States.

The new STRATCOM Signal Group consists of four battalions with 19 companies, headquartered at Richards-Gebaur; AFB, Mo.; Stewart AFB, N.Y.; Gunter AFB, Ala., and Fort Baker, Calif.

Col Higgins served 10 years in the enlisted ranks until he was commissioned in 1942. Subsequently he served with various Signal Corps organizations in Alaska, the U.S., Europe and Hawaii. He was deputy commander, 1st Signal Brigade in Vietnam (1966-67).

Col William A. Higgins

Kudos

Presentation of the Distinguished Service Medal (DSM) to Maj Gen Joseph L. Bernier upon his recent retirement as Assistant Surgeon General and Chief of the Army Dental Corps made him the first dental officer since World War II to receive this award.

Among numerous outstanding achievements during his seven years as head of the Dental Corps, the citation states, "General Bernier conceived, organized and directed the Army Preventive Dentistry Program, which met with enthusiastic acceptance throughout the world."

"He will certainly be regarded as one of the most important figures in the dental history of the century, and his many contributions to the Army Dental Corps will be remembered for years to come."

General Bernier received DDS and MS degrees from the University of Illinois (1932 and 1934), an FDS degree in 1949 from the Royal College of Surgeons, England, and an FRCM degree in 1961 from the Royal College of Medicine.

Upon completion of 33 years of military service, General Bernier joined the faculty of Georgetown University as a full-time professor and chairman of the Department of Oral Pathology.

Brig Gen Roger M. Lilly, CG of the 2d Region, U.S. Army Air Defense Command, Richards-Gebaur Air Force Base, Mo., also was awarded the DSM. It recognized exceptionally meritorious service as CG, Automatic Data Field Systems Command, Fort Belvoir, Va., and as U.S. Army Materiel Command project manager for Automatic Data Systems within the Army in the Field (ADSAF), April 1965 to October 1967.

"General Lilly's unique skill as an organizer, planner and administrator," the citation states, "has resulted in placing in the hands of today's military forces the Field Artillery Digital Computer, Automated Class II and IV Inventory Control and Supply Flow, and Tactical Imagery Interpretation Facility."

Col Mildred Irene Clark, who recently retired as chief of the Army Nurse Corps, was the first Army nurse in more than 20 years to receive the DMS. Col Florence A. Blanchfield, superintendent of the Army Nurse Corps during World War II, was similarly honored.

Col Roger Ray, new commanding officer of Picatinny Arsenal, Dover, N.J., was honored with the DSM for his service as military assistant to the Secretary of Defense (Atomic Energy), and later as chief of staff of the Defense Communications Planning Group, July 1965 to September 1967.

He was cited for his "outstanding leadership, diplomacy and ceaseless efforts which contributed to the alleviation of problems arising from the loss of nuclear weapons over Palomares, Spain, in January 1966 and for the successful execution of the nuclear test, Project Long Shot, on Amchitka in October 1965."

OUTSTANDING CIVILIAN SERVICE AWARD. A consultant to the Army on the Armed Forces Epidemiological Board was recently awarded the Outstanding Civilian Service Award by the Department of the Army.

Dr. John H. Dingle, director of the Department of Preventive Medicine at Western Reserve University, has served on the board 12 years and was president from July 1955 to December 1957.

The citation notes, "Motivated by patriotism and deep convictions of the scientist's public responsibility, and disregarding personal inconvenience, Dr. Dingle energetically discharged his duties to the board, and by his personal example inspired other scientists in reducing military manpower losses from disease and injury."

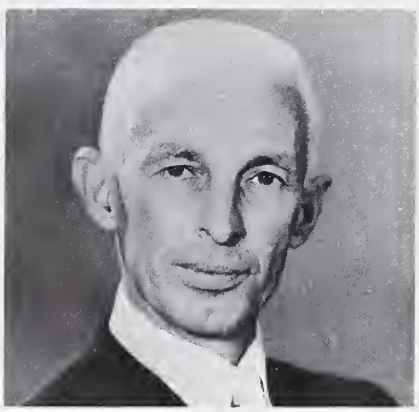
SILVER STAR. Col Wilbur H. Vinson Jr., chief of the Nike-X and Space Division, Office of the Chief of Research and Development, received the Silver Star for gallantry while serving with the 2d Battalion, 19th Artillery, 1st Cavalry Division (Airmobile) in Vietnam.

While leading an aerial reconnaissance unit to secure a forward area for an artillery battery Sept. 13, 1966, he landed his helicopter and led his team amid heavy sniper fire to the top of a

Thrailkill Wins Kent Ballistic Research Award

The Kent Award for 1967 went to Arthur E. Thrailkill, chief of the Propulsion Branch, Interior Ballistics Laboratory, U.S. Army Ballistic Research Laboratories (USABRL), Aberdeen Proving Ground, Md.

Established in 1956, the award is presented annually to USABRL employes for achievements in scientific or engineering fields. The award honors Dr. Robert H. Kent who gained many honors as one of the nation's leading ballistics experts. He served for many years as associate technical director of the Army Ordnance Ballistic Research Laboratories until he retired in 1956. Dr. Kent died in February 1961.



Arthur E. Thrailkill

Dr. Robert J. Eichelberger, USABRL technical director, presented this year's award to Thrailkill for numerous technical innovations directed at solving problems of printed circuits igniters, solid bipropellants, aluminum honeycomb propellants, combustible cartridge cases and small arms.

He also was cited for the ability he has shown, as a member of various committees, to exercise his technical insight in the context of a broader technology.

Thrailkill joined USABRL in 1946 after serving with the U.S. Army in the Pacific during World War II. He earned a BS degree in chemistry from Citadel College, Charleston, S.C., in 1942.

Engineer School Honors 28 RVN Veterans

Twenty-eight veterans of Vietnam were presented recently with awards ranging from Silver Star to the Air Medal by Brig Gen William M. Glasgow Jr., assistant commandant of the U.S. Army Engineer School (USAES), Fort Belvoir, Va.

Sp/5 Jimmy R. Force, 13th Field Hospital, received the Silver Star and Bronze Star with "V" device, and Capt Kenneth D. Allen, USAES, the Silver Star and Army Commendation Medal with "V." Other awards were:

Soldier's Medal, SFC Floyd W. Wadsworth, U.S. Army Engineer Center Brigade (USAECBDE). *Bronze Star with "V,"* Pfc William H. Ferrell, DeWitt Army Hospital. *Bronze Star* and *Air Medal,* M/Sgt Doy J. Williams, USAECBDE. *Bronze Star,* Capts William D. Green, John Knutzen, William Poggengurg, Robert J. Reilly, Phillip Shoemaker and 1st Lt Robert Steiner, all of the USAES student Officer Detachment; 1st Lt Donald Margeson, Office, Deputy Chief of Staff for Operations; and CW4 Carl D. Manning, Office, Deputy Chief of Staff for Logistics; and

1st Lt David Rhind, CW4 Jess A. Bean, CW3 Charles Anderson, USAES; CW2 Walter Kwasek, Sgt Maj Benjamin F. Young, U.S. Army Engineer Officer Candidate Regiment; 1st Sgt Emmet Morris, SFC Kermit Hester, and S/Sgts Richard L. MacDougall and Oscar Strickland, USAECBDE.

Air Medal, Capt Donald M. Rogan, USAES; S/Sgt Warren J. Butler, 13th Field Hospital; T/Sgt Leonard M. Sell, Nuclear Power Field Office; and S/Sgt Robert J. Hatmaker, Sp/4 Richard A. Stitt, and Sp/4 William Mahoney, USAECBDE.

small hill behind the assaulting infantry force and directed the selection of the artillery positions.

Lt Col Vinson (rank at that time) received the 3d through 5th OLCs to the Air Medal for meritorious achievement in Vietnam while participating in 25 aerial missions over hostile territory.

LEGION OF MERIT (LOM) Col Chester A. Hall Jr., head of the Test Directorate for the U.S. Army Electronic Proving Ground (USAEPG), Fort Huachuca, Ariz., during the past year, received the 2d Oak Leaf Cluster (OLC) to the LOM upon his retirement. His previous assignment was chief of communications-electronics for the U.S. Military Assistance Command in Vietnam.

Col Raymond E. Johnson, director of the U.S. Army Test and Evaluation Command (TECOM) Aviation Materiel Testing Directorate, received the LOM for outstanding services with the U.S. Army Aviation Test Board, a TECOM element at Fort Rucker, Ala. He served successively as special assistant to the president, deputy president and president of the board from July 1964 to July 1967.

Lt Col Charles L. Siler, information officer of the U.S. Army Combat Developments Command, Fort Belvoir, Va., was awarded the LOM for his service as information officer of the First Cavalry Division (Airmobile) in Vietnam.

His citation noted that "Because the unit was the first American division to enter the combat zone, the public interest and news media coverage was both enormous and continuous. . . . Maj Siler met these demands in a most difficult battlefield environment with enthusiasm and dedication. . . (resulting) in wide, accurate coverage of activities. . . ."

BRONZE STAR MEDAL (BSM). Lt Col Robert L. Alexander, now with the Studies and Analyses Division, OCRD, received the BSM for distinguishing himself in ground operations in Vietnam from August 1966 to August 1967. His citation states, "He was quick to grasp the implications of new problems with which he was faced as a result of the everchanging situations inherent in a counter insurgency operation and to find ways and means to solve those problems."

Maj Irving C. Morey, Doctrine Directorate, U.S. Army Combat Developments Command, Fort Belvoir, Va., also received the Bronze Star. He was cited for "distinguishing himself by outstanding meritorious service in connection with ground operations against a hostile force in the Republic of Vietnam during the period August 1966 to July 1967." Brig Gen Roy L. Atteberry Jr., director of Doctrine, made the presentation.

ARMY COMMENDATION MEDAL (ACM). Col Charles L. Beaudry, chief of the Army Field Office, Air Force Western Test Range, received the ACM with 1st OLC in recognition of his accomplishments "in establishing a vast network of associations with foreign research activities and military attaches" while assigned as commanding officer, U.S. Army R&D Group (Europe).

Col Harold F. Hamit, now chief of the Division of Surgery, Walter Reed Army Institute of Research (WRAIR), received the ACM for service as chief, General Surgery Service, Department of Surgery at Brooke General Hospital, Fort Sam Houston, Tex., during the past two years.

Lt Col Don W. Moore, Evaluation Directorate, U.S. Army Combat Developments Command, also received the ACM, as did Lt Col Carl W. Boyer, chief of Radiation Therapy, Walter Reed General Hospital (WRGH).

Lt Col Melvin C. Snyder Jr., newly assigned to the Studies and Analyses Division, OCRD, received the ACM for his service as chief of the Morale Services Branch and as chief of the Personnel Services Division, G1 Section, HQ 8th Army, Seoul, Korea, 1966 to 1967.

Maj William H. Doolittle received the ACM for outstanding meritorious service as chief, Medical Service, Bassett Army Hospital, U.S. Army Alaska, Yukon Command, September 1964 to June 1967. He is now chief of General Medicine Section II at WRGH.

Capt Michael L. Meuth, MSC, assistant executive officer and aide-de-camp to the CG of the U.S. Army Medical Research and Development Command, received the 1st OLC to the ACM for meritorious achievement while serving in Vietnam.

As medical attendant at the 2d Medical Dispensary (General), Soc Trang, Republic of Vietnam, he assisted in the medical treatment of 52 Vietnamese and 4 American wounded personnel from "Operation Dan Chi 135."

"His energetic application of his extensive knowledge materially contributed to the successful treatment of the mass casualties," the citation states, "and due to his efforts only one life was lost prior to the personnel evacuation from Soc Trang."

Swedish Geodesist Cited for USAETL Work

Swedish scientist Dr. E. Arne Bjerhammar earned the Army Certificate of Achievement for contributions to the Army's R&D programs while serving as director of the U.S. Army Engineer Topographic Laboratories' (USAETL) Research Institute for Geodetic Sciences.

The internationally known geodesist was commended for his outstanding scientific contributions and for the valuable leadership, guidance and motivation he provided during the formulative period of the institute and implementation of a long-range progressive plan for development and expansion.

The citation stated, in part: "A prime example of his scientific achievements is the concept of the 'Coalescent World Geodetic System,' which outlines a method to link terrestrial and satellite geodetic observations into one geodetic system.

"This system is based on a 'Space Geoid' in which, after a complete gravity reduction, all mass outside the reference surface is translocated below the reference surface in such a way that the external gravity field in space and at the surface is unchanged.

"Other outstanding achievements include his studies of an automatic electrical optical satellite triangulation system, a system for satellite triangulation by means of atomic clocks, and a new approach to satellite geodesy exploiting the relationship between the gravitational and kinetic potential of an orbiting satellite."

Dr. Bjerhammar joined the laboratories at Fort Belvoir, Va., as director of the institute, a PL-313 or "Super-Grade Position," in September 1966. He served also as a visiting scientist at the labs in 1963.

He graduated from the Royal Institute of Technology, Stockholm, in 1942 and received his technical doctorate in 1948. He served the Stockholm institute as assistant professor, professor, head of the Division of Geodesy, and dean of the Department of Surveying.

Prior to resigning in November to return to the Royal Institute, the geodesist attended the International Association of Geodesy meeting in Lucerne, Switzerland. He authored four papers on geodesy for presentation at the meeting.

Dr. Bjerhammar served as a visiting scientist at the National Research Council, Ottawa, Canada, in 1957; president of the Swedish Association of Engineers, Surveying Section, in 1958; president of the International Association of Geodesy's Study Group for Statistical Methods; and lecturer at a number of leading colleges and universities in the U.S.

SWEDISH GEODESIST Dr. E. Arne Bjerhammar receives Army Certificate of Achievement from Col Edward G. Anderson Jr., USAETL commander.

The Atom: Developing Peaceful Uses Through Research

By Dr. Glenn T. Seaborg, Chairman, Atomic Energy Commission

Reprinted with permission of the author and the editor of "Perspective," quarterly periodical of the Cornell Aeronautical Laboratory, Inc., of Cornell University. The article appeared in the 1967 third quarter edition.

* * *

By its very nature the peaceful atom is a rather "silent servant of man." Because of this inherent quality, developments in recent years in the peaceful uses of the atom, while spectacular in their variety and significance, often have tended to go unnoticed, overshadowed by the military atom.

Relatively few people are aware that the growth of the peaceful atom has been so great that today more than 50 percent of the Atomic Energy Commission's budget is devoted to work in this area, whereas a few years ago only a quarter of the budget supported the peaceful atom.

Although this trend is bound to continue, attainment of the peaceful atom's full potential surely will depend in good part on the support and encouragement of informed people.

The attribute of the peaceful atom that is receiving the greatest attention today is its ability to produce heat to generate electricity.

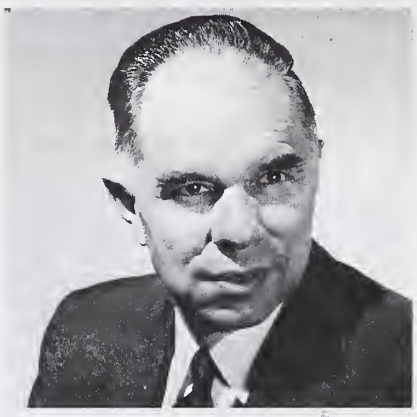
In the Nick of Time. There has been a remarkable rise of nuclear power within the past year and a half. Seventy-five plants with a combined capacity of about 50,000,000 kilowatts should be "on the line" before 1975. Projections indicate that by 1980 we should have an operating nuclear power capacity of about 150,000,000 kw. By the turn of the century, total nuclear capacity is expected to be about 700,000,000 kw.

What has accounted for this remarkable surge and why are we so optimistic about the future? After 20 or more years of research and development we have reached the stage where the nuclear reactor can show decided advantages in the generation of power.

There is little doubt that nuclear energy opens up vast new resources at a time when the world's demand for energy

Yankee Atomic Electric Co. photo

Yankee Atomic Electric Plant, Rowe, Mass.



AEC photo

Dr. Glenn T. Seaborg

is rapidly expanding. If we project our population growth, the growing power demands of our technological civilization and the even more rapidly increasing demand for electricity, it becomes obvious that the world's fossil fuel resources alone could not fill our needs.

In addition, we will need these valuable hydrocarbons for growing uses in our chemical industries. So, historically speaking, the use of nuclear energy has arrived in the nick of time.

Nuclear power's timeliness is important also in relation to our current concern over environmental pollution. Nuclear power plants do not add to the burden of air pollution because they do not create combustion products and their waste is contained and disposed of in a controlled and safe manner.

The economic advantages of nuclear power stem from the fact that nuclear plants use a long-life fuel which makes them relatively independent of geography and from the further fact that these plants, in the larger sizes being built and planned today, are expected to produce electricity cheaper than conventional plants — in some cases even in or adjacent to areas where fossil fuels are naturally abundant.

At some time in the future we may be able to use the intense heat of reactors economically to turn coal into a liquid for chemical uses or to convert it to a gas so that it can be conveniently transported through pipelines.

Desalting the Sea. One more current development of the peaceful atom that will be attracting greater attention in the U.S. and around the world is the use of nuclear power to desalt seawater and brackish water. A large dual-purpose nuclear plant is being planned for the Los Angeles area. This plant will produce 1,800,000 kw of electricity as it desalts 150 million gallons of water a day.

Through nuclear power we hope to use seawater in another way — that is, by using the heavy hydrogen in the oceans to generate power through controlled fusion. Solving the problems of controlled fusion is incredibly difficult and will take some time, but our laboratories are at work and making progress. Success will certainly be worth any effort we put forth; for fusion of the atoms of heavy hydrogen available in the oceans of the world will open up an energy resource equivalent to 500 Pacific oceans filled with high-grade petroleum.

Portable Power. Small reactors are

States Marine Lines photo

***Savannah* sailed four years and 130,000 miles on initial nuclear fueling.**

finding an important place as reliable and independent sources of power in remote areas; this use of nuclear power is bound to grow. The Navy for almost five years now has been using a portable small reactor at McMurdo Sound in the Antarctic, to supply power to a National Science Foundation-sponsored scientific community there. During the past year this reactor has also been effectively used to desalt seawater for the community, although it was not originally designed for this purpose.

Another portable nuclear plant has been in use since 1962 in a remote section of Wyoming, where it supplies power for an Air Force weather station.

Still another interesting example of a portable — or at least a "towable" — nuclear power reactor is the 10,000 kilowatt plant mounted on a barge, which can be towed to any offshore anchorage where emergency power is needed. It can supply enough electricity to meet the needs of a community of from 10,000 to 20,000 people.

Power for the Seas. One example of nuclear power that definitely does not have to be towed is the nuclear ship *Savannah,* which in its four years at sea has demonstrated the reliability of nuclear power for the propulsion of merchant ships. On its initial fuel loading the *Savannah* has recorded more than 130,000 miles of trouble-free cruises to the world's leading ports, including a year of commercial service.

Although the *Savannah* was designed as a demonstration ship and was not meant to be economically competitive with conventional ships, it has definitely pioneered the way to the future era of nuclear ships. Nuclear-powered ships with smaller but more powerful reactors, highly automated equipment, and containerized cargo-handling gear will inevitably play a major role in worldwide shipping.

Nuclear power will play an important role in our use of the sea for other than purely transportation purposes. The world's oceans represent a vast source of untapped wealth — in terms of scientific knowledge and natural resources. From all indications nuclear power is going to be one of our most valuable aids in exploring and using this source of wealth. Nuclear submarines and undersea research vessels such as the NR-1 (the Deep Submergence Research Vehicle being built by the Navy and AEC) will help greatly to open up this new frontier. The NR-1 will be able to cruise along the bottom of the continental shelf for 30 days at a time, supplying all the necessities of life and tools for undersea investigation for its two scientists and three crew members. Other nuclear-powered undersea vessels will no doubt follow, not only for scientific and technical use but perhaps someday as pleasure craft revealing to us a new world of natural wonders.

When it comes to extracting and processing the many valuable resources in the sea and on the ocean floor — such as food, minerals, and other materials — the extensive use of nuclear power will probably become essential.

Atoms in Space. In our space program, nuclear energy has already become an indispensable source of auxiliary power. We have successfully operated in orbit Systems for Nuclear Auxiliary Power (SNAP, devices) which generate electricity through the use of radioisotopes and small, compact reactors. These have ranged from our SNAP-10A reactor system which operated in orbit for 43 days generating 500 watts of electricity, to the SNAP-3 isotopic system which has been supplying several watts of power to a Navy navigational satellite in orbit since June 1961.

A variety of new SNAP systems is under development now, including one that will increase our life-support capability in space by powering a recycling system that will produce 15 pounds of fresh water per day from space capsule waste.

Not only will the future see an expanded use of this type of nuclear power in space, but we should see important progress in the development and use of nuclear powered rocket systems.

Pan Am photo

NERVA nuclear rocket engine, which will use a desk-size reactor to produce 200,000 pounds of thrust, undergoes testing at Jackass Flats, Nev.

In ground testing a prototype nuclear rocket reactor, we have already achieved a continuous power run equal to the reactor time required for a trip to Mars. These nuclear reactors for space propulsion must produce a tremendous amount of power for their size. The NERVA nuclear rocket engine, on which the AEC is working in cooperation with NASA, will use a flyable, compact reactor, little larger than an office desk, which will produce 200,000 pounds of thrust. In a nuclear rocket engine such a reactor heats liquid hydrogen to thousands of degrees and the hydrogen's tremendous expansion through the rocket nozzle produces the necessary thrust.

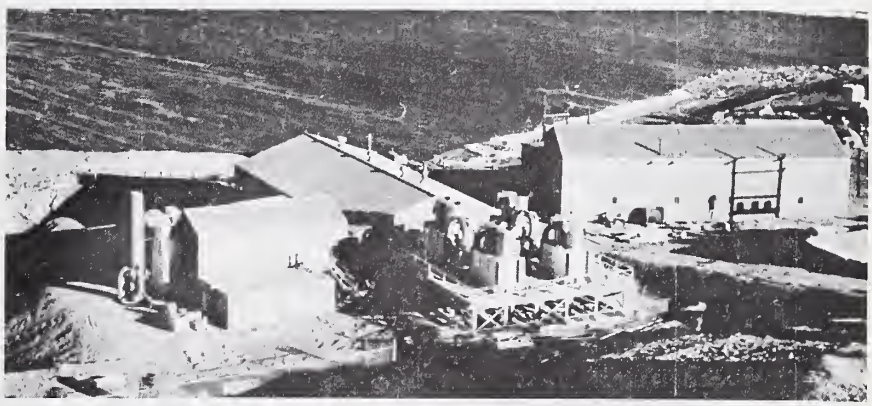
Nuclear power will be essential for making manned voyages to the planets. Low-thrust and low-weight nuclear electric systems could be used to reduce the travel times for distant space missions. Nuclear-powered devices will also be used to sustain life and essential functions during voyages.

Once we reach the planets, we will need nuclear power to operate our scientific, communications and life-support equipment. Long-life electric power generators will be required for laboratories and observatories and to create and maintain an environment that will enable man to survive and function effectively.

Before this takes place, however, we will probably see orbiting nuclear-powered satellites in an important role. These will someday include synchronous communication satellites providing worldwide communications of all kinds, including television direct to homes any place on the globe. A network of nuclear-powered weather satellites, in conjunction with nuclear-powered unmanned weather stations in remote areas on land and at sea, will provide us with remarkably accurate long-range weather forecasting. Some of these SNAP-powered space, terrestial and marine stations have already seen service, are in use today, or will go into use soon.

Atomic Plowshares. We will someday

(Continued on page 30)



Martin Co. photo

NAVAL STATION at McMurdo Sound Antarctica, has used a portable reactor to heat and power a National Science Foundation community for five years.

Developing Peaceful Atoms Through Research

(Continued from page 29)

find a way to overcome the technical and political roadblocks to realizing the many benefits that can accrue from the peaceful applications of nuclear explosives — the Plowshare Program.

What are some of the peaceful applications of nuclear explosives? They may provide the most economical and quickest methods of large-scale excavation for projects such as canals, mountain passes or manmade lakes. They may be used underground to stimulate the emission of natural gas, to produce oil from shale, to leach minerals from low-grade ore deposits and to create large underground storage cavities. These are applications capable of effecting huge savings and of accomplishing many things that could not be done readily by conventional means. We have AEC programs under way now, in cooperation with other government agencies and private industry, to develop the best means of using these valuable applications of the atom's power.

Turning from nuclear explosives, we find at the other end of the energy spectrum the quietest, most unobtrusive of the peaceful atoms — but the most versatile and in many ways the most valuable. These are the radioisotopes used in biology and medicine, agriculture, industry, and in all types of research, basic and applied.

Medical Uses are Many. Perhaps one of the first practical uses of the radioisotope was made about 1911 when George de Hevesy, a pioneer in the use of radioisotopes, performed a secret experiment in the boarding house in which he lived. By placing a tiny trace amount of a radioactive material on his unfinished dinner one night, he was able to confirm his suspicion that his landlady was using the boarders' leftovers in the next evening's hash!

We've come a long way since de Hevesy's experiment in using radioisotopes to improve our health. Over the past 30 years more than 100 different radioisotopes have been used in medical research. Today more than 10,000 doctors and medical organizations in the United States alone routinely use some 30 different radioisotopes in the diagnosis and treatment of many diseases and disorders.

For example: Cobalt-60 has been very succesful as a source of radiation in treating several forms of cancer.

Iodine-131, one of the most useful radioisotopes, is used in blood volume and cardiac studies. Its most extensive use is in diagnosing and treating thyroid disorders.

Carbon-14 is used to study metabolic diseases underlying diabetes, gout anemia and a glandular disease, acromegaly, in which the bones and soft parts of the hands, face and feet become enlarged.

Sodium-22 and -24 are used to measure blood volume and diagnose circulatory disorders.

Union Corbide Corp photo

BIOLOGIST isolates aging granules from human heart tissue in a zonal centrifuge at the Gaseous Diffusion Plant, located in Oak Ridge, Tenn.

Some medical applications of the peaceful atom are a bit different from the uses of radioisotopes just reviewed. The first is the use of radiation and high energy beams from accelerators to destroy tumor cells. These include protons and helium ions, and may some day include a pi meson beam (more intense than the meson beams available today) from the "meson factory" accelerator proposed for construction at the Los Alamos Scientific Laboratory and heavy ion beams from the Omnitron facility planned at the Lawrence Radiation Laboratory at Berkeley.

Still another medical application involves the use of a radioisotope as a power source for an artificial organ. Work is already under way to develop a plutonium-powered heart pacemaker, which would be surgically implanted in the patient. In addition, an entire artificial heart, also powered by a radioisotope such as plutonium-238, thulium-171, or promethium-147, is under development. Since the half-life of plutonium-238 is almost 90 years, we might be able to add such years to our lifespan — if we can find a way to keep the rest of ourselves in good enough shape.

Atoms on the Farm. Radioisotopes and radiation have played an important role in agriculture. This is a role that is continuing to grow in its importance as we seek new and better methods to produce more food for a hungry world. Radioisotope tracers have helped agricultural researchers to develop healthier plants and farm animals by revealing the most productive kinds of fertilizer and feed.

The Department of Agriculture, with AEC cooperation, is building an irradiator which employs a radioactive source to deinfest stored grain. Additionally, through controlled use of its radiation, the atom can prolong the shelf-life of many foods to prevent spoilage that occurs during marketing or transport. It can allow meats, such as fresh fish, a wider distribution with less chance of spoilage, inhibit sprouting of potatoes, and keep fruits edible for a longer period of time. All these contributions of the peaceful atom to food production and preservation are being developed further to help meet the world's food needs of the future. The ACE and the U.S. Army Materiel Command's Natick (Mass.) Laboratories are cooperating in this development.

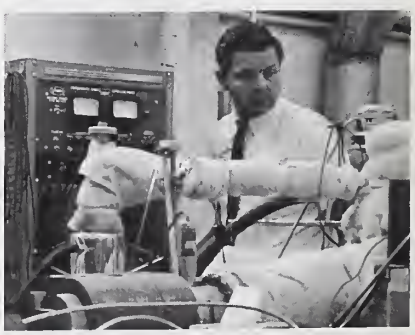
Industry and the Atom. Radioisotopes are making a substantial contribution to the world's industry — one amounting to savings of millions of dollars annually.

Radioisotope gauges of extreme sensitivity are used routinely today in many major industrial plants to measure the thickness and density of materials, and their heights or levels within containers. In some cases, with an accuracy of within a millionth of an inch, they automatically monitor and adjust the thickness of sheet steel, paper, tire cords, textiles and dozens of other materials. They control the amount of glue on postage stamps, the amount of sugar in applesauce, the amount of fat in baby food, and the amount of beverage in a beer can.

The use of radioisotopes in industry contributes to safety in two ways: many gauging techniques eliminate previously dangerous testing jobs on the part of workers (such as the clipping of hot sheet steel samples for thickness measurements); and the technology of radiography (using a radioactive source to "X-ray" the seam welds of boilers, ships' hulls, etc.) eliminates potentially dangerous flaws in materials or workmanship.

In another application, radioisotopes such as cobalt-57 and americium-241 are used in a process called X-ray fluorescence analysis, by which small samples in industrial processes or of scientific interest can be subjected to accurate nondestructive analysis in less than a minute. This process has numerous other applications including the determination of the authenticity of art masterpieces.

Radiation from radioisotopes is also helping to create new products and materials for industry. These include a wood-plastic combination formed when radia-



PROBING the blending of chemical and physical events at the molecular level, Cornell Aeronautical Laboratory physicist Robert Fluegge bombards gases with alpha particles in an Atomic Energy Commission-sponsored task.

Union Corbide Corp. photo

FEASIBILITY STUDY of a 2-mile railway and highway pass through the Bristol Mountains in California. The nuclear plowshare concept, which makes it possible to cut a path and clear debris in one operation, may provide the most economical and quickest method of large-scale excavation for canals, mountain passes or lakes.

tion polymerizes (links up) the molecules of a liquid plastic creating a highly desirable new material that will be ideal for a variety of new products. This process has also created heat resistant plastics, and a new surface coating that dries almost instantly when treated with radiation.

CAL Studies Test Data. A number of radiation applications are based upon widely understood phenomena which have been given the broad name "radiation effects." We know, in a general way, what happens when radiation enters into a reaction. Details of these mechanisms have yet to be filled in. At this, the molecular level, several scientific disciplines merge. This explains why Cornell Aeronautical Laboratory is doing a physics research study under an AEC biomedical contract.

Primary and secondary events that occur as a result of bombarding gases with alpha particles are being investigated at Cornell Aeronautical Laboratory under the direction of CAL physicist Robert Fluegge. Experiments include ion-molecule reactions and ionization probabilities by secondary electrons and by highly excited atoms. In view of the predominance of water vapor in biological systems, initial experiments have concentrated on studying charged particle interactions with water vapor. The research, of course, is one which may provide basic information on radiation damage to living materials.

Experimental procedures in the CAL study begin with the introduction of a single particle of known energy into the reaction chamber where it is detected. The chamber is surrounded by an ultra-high vacuum system. Subsequent reactions in the chamber are observed. Each series of events is followed by sampling the number and mass of the ions after a predetermined reaction time has elapsed. The observations are aided by a fast solid-state detector, time-of-flight analyzer, change separator, and data-handling system.

The information arising from this study at CAL, and others in AEC and university laboratories elsewhere, will considerably advance our understanding of the blending of chemical and physical events at the molecular level.

Atoms Beget Atoms. Another research and investigate technique has proved highly useful and intriguing in its future possibilities. This technique, neutron activation analysis, can detect the most minute amounts of an element in a material or object. It has become a very important means of nondestructive testing, a tool for scientific research and even for criminal investigation. We can measure impurities in metals, detect pesticide residues on crops, analyze the paint on art masterpieces, and in the near future possibly determine the chemical composition of the surface of the moon and planets.

Someone once remarked that AEC scientists have made atoms do just about everything except reproduce another atom. Actually, we have a program for making new atoms — transplutonium elements — in quantities which some day may prove quite useful in medical, industrial, space and scientific applications. These include curium-242 and curium-244 for use like plutonium-238 as heat sources to furnish compact sources of electric power for use in quantities which some day may prove in numerous applications on earth and in space, americium-241 for numerous uses in industry, and californium-252 for use as a point neutron source for medical, industrial and scientific applications. This is a program which is being carried on at the Savannah River Plant and Oak Ridge National Laboratory.

With all these uses of the atom being put to work, we continue to study the atom and its remarkable nucleus — to probe it, explore it, to break it down to smaller and smaller particles and analyze their behavior, even through the lifetime of some of these particles may be something on the order of a billion-billionth of a second.

From all the work and applications described here many additional benefits have evolved in the form of products and processes. These atomic bonuses include better color television through the use of rare earth phosphors in the picture tube; the preparation of a cold vaccine made possible by virus separation with the aid of the ultracentrifuge (the result of work at AEC's Oak Ridge gaseous diffusion plant); better well drilling techniques; and a variety of other developments that are benefitting both industries and individuals.

Thus it is clear that a new kind of nuclear proliferation, the proliferation of the peaceful atom, is taking place. Anyone who has been with the atom so long, seen so much of its development, and nurtured some of its growth may be permitted a prediction that the day is not far off when, in picking up our newspapers and reading of nuclear matters, the image that is evoked will not be the nuclear weapon but will be that of the growing and beneficial uses of the peaceful atom.

CRD Lauds Achievements Of Fort Detrick Scientists

Chief of Research and Development Lt Gen Austin W. Betts acclaimed the many notable scientific achievements at Fort Detrick, Md., in speaking there Nov. 17 to the Biological Section of the American Ordnance Association on R&D results for the Vietnam War.

"The accomplishments at the post," he said, "are matched by few laboratories anywhere in the world. In the field of vaccines and toxoids alone, they have developed effective protective immunizing agents against tularemia, anthrax, Venezuelan Equine Encephalomyelitis and each of the five types of botulinal toxins.

"I know of no other laboratory, governmental or industrial, that has been this successful in the development of effective vaccines during the past 25 years."

General Betts noted that "the more than 1,300 papers published in the open scientific literature have established Fort Detrick as an authoritative center for information in such diverse fields as aerobiology, infectious disease, laboratory safety, microbial genetics, and plant and animal diseases.

"The standing of this group in the professional community is attested by their election as officers and their appointment to editorial boards of some of the most highly respected scientific organizations in this country. Yours has certainly been a job well done. We of the R&D community encourage your continued high-caliber support."

Science Conference Papers

(Continued from page 4)

Vietnam" during separate 2-hour panel sessions.

Prior to the conference, a panel of judges representative of experts in the various scientific disciplines will select winners of cash honorariums and Certificates of Achievement. In 1966 the judges selected 12 papers for awards totaling $3,800, presented through the Department of the Army Incentive Awards Program.

The trend toward multiple authorship of papers presented at the conference is strongly evident in the 1968 selections. One paper has 8 authors, 5 papers have 4 authors each, 16 are authored by 3 persons, and 21 have 2 authors. Sixteen papers to be presented by officer and enlisted scientists will have a total of 26 authors.

The authors, titles of papers they will present and the installations at which they are employed are as follows:

OFFICE, SURGEON GENERAL—*Mechanisms of Action of Antimalarial Drugs*, by Dr. Fred E. Hahn, Walter Reed Army Institute of Research (WRAIR), Washington, D.C.; *The In Vivo Localization of Staphylococcal Enterotoxin B*, by Capt Sigurd J. Normann and Robert F. Jaeger, U.S. Army Medical Unit, Fort Detrick, Md.; and *The Effects of Antibiotics, Corticosteroids and Peritoneal Lavage on Experimental Peritonitis*, by Dr. H. Kenneth Sleeman, John W. Diggs and Col Harold Hamit, WRAIR; *Research Goals for Improved Blood Logistics*, by Lt Col Charles E. Shields, Lt Col Frank R. Camp Jr. and George H. Seeger, U.S. Army Medical Research Laboratory, Fort Knox, Ky.; and

In Vitro Growth of P. knowlesi: A Model to Study Metabolism of Malarial Parasites and Action of Antimalarial Drugs, by Dr. Herman Polet, WRAIR; *Chromosome Transfer Between Escherichia coli Hfr Strains and Proteus mirabilis*, by P. Gemski Jr., J. A. Wohlhieter and L. S. Baron, WRAIR; *Experimental Scurvy in Man*, by E. M. Baker, H. E. Sauberlich, S. C. March and R. E. Hodges.

(Continued on page 35)

AVLABS Role Shown by Contracts Scope

(Continued from page 5)

standing of the mechanism of load transfer through the composite material made up of fibers embedded in a matrix is being undertaken by the NARMCO R&D Division of the Whittaker Corp. on a $93,062 contract.

Concepts developed by the company for a micromechanical analysis of stress-strain relationships in a composite will be applied in the study. The analysis will be verified by a photoelastic stress on 3-dimensional oversized models.

A new aircraft propulsion concept, a convertible fan/shaft engine, is being investigated by the Allison Division of the General Motors Corp. on a $71,500 contract.

A lightweight propulsion system that can operate efficiently at low helicopter speeds and high fixed-wing aircraft speeds is necessary to exploit fully the potential of the composite aircraft.

The convertible fan/shaft engine has a propulsion configuration that combines characteristics of turboshaft and turbofan engines. The result is a unit capable of providing fan thrust for the high-speed mode that can be converted to supply shaft power to a rotor in the low-speed mode.

The engine would ideally produce 2,000-shaft horsepower at Army hot day conditions or 3,500 pounds fan thrust at 400 knots speed.

Emulsified fuel optimization and demulsification is the subject of a $68,472 follow-on contract with the Monsanto Research Corp. to improve the physical characteristics of a recently developed JP.4 emulsified fuel.

Another phase of the program involves the design fabrication and demonstration of a small-scale demulsification unit capable of being scaled-up for field use if the Army emulsifies JP.4 for transport and storage in a combat environment. The unit would be used in forward areas to reclaim liquid JP.4 from the emulsion prior to its being supplied to aircraft.

In combat situations, large projecting areas of a helicopter's transmission lubrication and cooling systems are exposed to damage. A $59,568 contract was awarded to Sikorsky Aircraft to investigate concepts of oil heat-rejection systems which do not require remote external cooling, and to develop concepts which may be applied as a simple retrofit to existing systems.

The study will include a comparative reliability, maintainability and vulnerability analysis of present helicopter external cooling systems and the proposed integral cooling systems. Vertol Division also will investigate new concepts of fluid heat-transport systems on a $64,732 contract.

The objective is to derive criteria for the design of power transmission lubrication oil-cooling systems which will project significantly smaller areas than current systems. The study will include the consideration of dynamic heat pump and refrigeration systems as well as integrated sump oil-to-air heat exchanges.

Vertol Division is performing a $65,000 study for increased survivability for flight control systems. This will involve measuring the survivability of the CH-47A aircraft with design, experimental fabrication, installation and test of critical components of the systems and subsystems.

AVLABS is continuing efforts to obtain stabilization systems for V/STOL aircraft that are reliable, lightweight, inexpensive, easily maintained and readily stored. As part of this program, the Aeronautical Division of Honeywell, Inc., received an $83,250 contract for exploratory development of the fluidic yaw damper system.

In preparation for a flight test program, AVLABS will obtain the design of the equipment, installation, vehicle power sources, fabrication and bench testing of the damper system hardware.

Bell Aerosystems Co., a division of Bell Aerospace Corp., received a $99,692 contract to improve the method of correlating data derived from various ground-based simulators and actual flight aircraft.

The program will be carried out in coordination with the Development and Demonstration Flight Test Program of the X-22A V/STOL aircraft.

AVLABS has also awarded two contracts for equipment related to aircraft missions. An encapsulated casualty pickup container for use with the present surface-to-air pickup system will be designed, developed and tested by Aerostructures for $99,628.

Proposed by the U.S. Army Special Forces at Fort Bragg, N.C., the capsule would provide for evacuation of casualties from remote and treacherous areas where medical personnel are not available and other means of evacuation are impractical or unavailable.

The Special Forces require a heavy-duty, lightweight capsule with special padding to conform to different sized patients. It would be parachuted with other kit components to the pickup site and retrieved by an aircraft with a surface-to-air pickup system.

The concept is that in a matter of minutes after injury the patient would be placed in the capsule connected to a 500-foot nylon rope held in the air by a helium-filled balloon. Upon seeing the balloon, the pilot of the aircraft would lock onto the rope. While the balloon bursts or drifts harmlessly away, the capsule with the patient would be reeled up and loaded aboard.

Capable of being hoisted to a hovering helicopter by means of a winch, the capsule would also incorporate carrying handles and provide the maximum of patient comfort. It is expected to be used as a litter in transporting the patient to the destination medical facility by other various modes of travel, thereby eliminating unnecessary transfer and possible added injury to the patient.

AVLABS is maintaining a continuous close working relationship with the Army Surgeon General's Office for necessary medical guidance on the project.

The Air Force has agreed to provide the necessary aircraft, crew and facilities support for tests by the contractor expected to start early in 1968 at Eglin Air Force Base, Fla.

Brooks and Perkins, Inc., received a $76,500 contract for design, fabrication and proof-testing of 20,000-pound capacity cargo pallets for the CH-54 aircraft.

Suspended from four points on the CH-54, the pallets will increase the capability of the aircraft by facilitating delivery of cargo, in addition to its other missions.

Col Strock Heads Washington Field Office of Mallard Project

Col Robert D. Strock

Brig Gen Paul A. Feyereisen, the Mallard Project's U.S. program/project manager, has announced assignment of Col Robert D. Strock as deputy project manager in charge of the Washington Field Office.

Purpose of the Mallard Project, headquartered at Fort Monmouth, N.J., is to develop a field communications system for the armies, navies and air forces of the U.S., Australia, Canada and the United Kingdom.

Col Strock was until recently commanding officer of the 304th Signal Battalion in Korea. Other assignments include program director, Autovon Program, Defense Communications Agency, May 1962 to June 1965; Office of the Chief Signal Officer, 1959 to 1962; and chief of the Technical Division on the ACE-HIGH (troposcatter system), HQ SHAPE, 1956-59.

Col Strock holds a BS degree from The Citadel, an MS degree in electrical engineering from the University of Illinois, and is a graduate of the Canadian Army Staff College and the Army War College.

Besson Stresses Creativity to Lab Leaders

(Continued from page 1)

management authority in his operational area."

In introducing his encouragement to break with restrictive precedents in promoting new ideas — in dealing aggressively with the problem of "coupling," that is, of making new research knowledge more effectively applicable to materiel requirements — General Besson quoted from a 1921 book, "The Soul and Body of an Army," by Sir Ian Hamilton:

"Inventions do not make their first bow to armies on the battlefield. They have been in the air for some time; hawked about the antechambers of the men of the hour; spat upon by common sense; cold-shouldered by interests in what exists; held up by stale functionaries to whom the sin against the Holy Ghost is to break a precedent."

General Besson said that he is in accord with Dr. Thomas in considering that problems existing in Army R&D and laboratory management can be grouped, broadly speaking, under three headings: Efficiency, Quality and Military Relevance.

With respect to quality, he said the entire AMC workforce must raise its sights to zero in on materiel development objectives. Talented young scientists also must be recruited to supplement the capable and experienced but aging group — representative of the wave of talent that became available in World War II.

Dr. Thomas presided at a panel discussion on how AMC laboratories can be more effective in assisting the 57 project managers, four of whom were panel members. The consensus was that laboratory directors must be more aggressive in selling their views on the best ways to expedite programs in the final stages of engineering development.

Project managers who served on the panel were Brig Gen Paul A. Feyereisen, U.S. program/project manager of The Mallard Project; Lt Col James K. Hoey, Project Combat Vehicles; Lt Col Mose E. Lewis, Project Aircraft Weaponization; and Charles A. Cockrell (acting manager), SAM-D.

Dr. Thomas also announced that his office will begin early in 1968 to compile a quarterly summary of the Materiel Command laboratory accomplishments that are oriented toward stated requirements in Vietnam.

Col Donovan F. Burton, commanding officer of the U.S. Army Research Office-Durham (N.C.), discussed many of the research problems related to Southeast Asia, with emphasis on Vietnam. He said members of the Army scientific community must be brought into a closer personal relationship to achieve a synergistic uplift of the entire R&D effort.

Col Burton suggested the problem of more effective coupling of basic research results to the need for significant advances results to the need for significant advances in materiel can be alleviated by encouraging more visits of Army scientist to those in the academic and industrial communities and by continued emphasis on their reciprocal visits to Army laboratories as consultants. He also advocated increased effort to encourage scientists from the outside community to accept special work in Army laboratories for extensive periods.

The Army Research Office-Durham is concerned with Army-wide management of basic research. Col Burton proposed that ARO-D scientists go on extended tours to Army laboratories to facilitate an in-depth appreciation of research objectives, levels of effort, major problem areas, and capabilities to develop feedback into the overall program, as well as all coupling activities.

James E. Keat reported on Army Missile Command initiative in permitting members of its staff to go to Southeast Asia to study problems. He served three months in Vietnam in 1967 as a consultant to the staff of Dr. William G. McMillan, scientific adviser to General William C. Westmoreland.

In this assignment, Keat worked with several other technical experts recruited from AMC laboratories in solving some equipment problems of combat units.

Dr. Hans K. Ziegler, deputy for science and chief scientist of the Army Electronics Command at Fort Monmouth, N.J., told how the command maintains an R&D team of seven engineering and scientific personnel in Vietnam to achieve rapid response to critical requirements.

Among ECOM results cited by Dr. Ziegler in responding to Vietnam needs were 286 specific actions, of which 121 are completed, 141 in progress and 24 in the planning stage. He said the increasing flow of data from Vietnam will greatly assist future R&D in electronics.

Another major speaker on Army R&D contributions to Vietnam requirements was Oscar Cleaver, acting technical director of the Army Mobility Equipment R&D Center, Fort Belvoir, Va. Among numerous items he listed were special transporters for CONEX containers, construction equipment sectionalized for air transport, and equipment for rapid removal of the vegetation that often shelters the enemy.

Cleaver also mentioned various types of bridges developed for Vietnam conditions, expendable rollers for mine clearing (due for delivery in January), experimental tunnel detectors, armor kits to protect heavy equipment operators from sniper fire, explosive foxhole-digging aids, and a guerrilla detector.

"Life Support Equipment for Vietnam" was the topic of a presentation by S. J. Kennedy of the U.S. Army Natick (Mass.) Laboratories. His talk was focused on the new Fire-Resistant Flight Uniforms for Army Aviators and the Variable-Type Body Armor for Ground Troops.

Kennedy said the new flight uniforms are now in production and are made of duPont Nomex polyamide fiber to ensure lower levels of skin burns. The material has a quality of self-extinguishing of fires. The uniforms will replace the Air Force flight clothing that has been used.

Variable-Type Body Armor offers a 5-way option to the wearer. He can wear the entire assembly of two ceramic plates and the nylon felt vest, or any part of it, depending upon the combat situation and the limitations imposed by level of activity and the climate. Kennedy said 2,000 sets of armor are being produced for evaluation in Vietnam.

Arthur Levine of the Natick Laboratories discussed the NLABS Equipment Coordination Program. Results are providing the scientific director with information necessary for making decision on the most effective use of his equipment resources consistent with mission requirements and budgetary limitations, Levine stated.

Interest of participants was high in "The 10-Year Plan for Army Materiel Command Laboratories," discussed by Norman Klein, chief of the AMC Research and Laboratories Operations Division. Details of the plan will be distributed to installations concerned in the near future, and will be reported fully by the *Army R&D Newsmagazine*.

Technical Director John L. McDaniel of the U.S. Army Missile Command, Redstone Arsenal, Ala., also made one of the major presentations on "Standards for Research and Engineering Personnel Management."

In discussing the complexities of this problem, McDaniel cited statistics contained in a Triennial Technical Survey Report issued by Dr. Thomas in July 1967, showing the need for improvement in the quality of personnel and management of AMC in-house laboratories. In June 1967, Dr. Thomas established a task group to develop standards for research and engineering personnel management.

McDaniel outlined the findings and recommendations of the study group which are proposed for publication in an AMC circular. One of the basic provisions is the use of "peer" panels in all four recognized areas of personnel management. The purpose of the panels is to advise the supervisor and civilian personnel officer on qualifications, training needs, potential for development, and contributions to R&D progress.

Representing the Office of the Director of Defense Research and Engineering at the conference was Edward Glass, assistant director for Laboratory Management, who spoke on the subject at a luncheon meeting. He also participated in general discussions of the topic.

Assistant Secretary of the Army (R&D) Dr. Russell D. O'Neal was among the participating dignitaries.

R&D Women Nominated for High Honor

Two Army research and development employes are among six Department of the Army nominees approved by Secretary of the Army Stanley R. Resor for the Eighth Annual Federal Woman's Award.

Dr. Caroline tum-Suden is a pharmacologist in the Physiology Department of the Medical Research Laboratory at Edgewood Arsenal, Md., and Mrs. Grace C. Boddie is chief of the Research Support Management Office, U.S. Army Research Office-Durham, N.C.

The awards are presented annually to provide special recognition to women who have made outstanding contributions to the efficiency and quality of the career service of the Federal Government, to encourage high standards of performance from other women in government, and to publicize the wide variety and satisfaction of federal careers.

A maximum of six awards, government-wide, may be made in any one year for outstanding ability and achievement in an executive, professional, scientific or technical position.

Eligibility may be based upon achievements having an important effect on a major government program, or upon specific outstanding accomplishments which have made an important contribution to administrative, social, scientific or technical progress in the work of a federal agency.

Demonstration of leadership or sustained individual performance showing a high degree of personal integrity, honesty and judgment are among the criteria for the award.

Dr. tum Suden, who has worked since 1950 at Edgewood Arsenal was nominated for her contributions to the understanding and treatment of disturbed body functions resulting from abnormalities of the adrenal glands.

In addition to her "consistently superior performance of research," the nomination justification noted that her tutelage and example have been a beneficial influence on many of the young people on the Arsenal's research team.

Much of her researcch since completing her education has been concerned with the deleterious effects of disturbances of normal adrenal functions. It was noted that her findings "contributed to the present success of physicians in dealing with adrenal insufficiencies, pheochromocytoma and other diseases of the adrenal glands."

Dr. tum-Suden holds a BA degree from the University of California, Berkeley (1922), an MA degree from the Columbia University College of Physicians and Surgeons (1927), and a PhD degree in physiology from the Boston University School of Medicine (1933). She has held research and teaching positions at Mount Holyoke College, Boston University School of Medicine, and Evans Memorial Hospital.

She is a member of the American Association for the Advancement of Science, the New York Academy of Science, the American Physiological Society and Research Society of America.

MRS. BODDIE has a wide educational and professional background, including service as a teacher and principal in the Virginia public school system from 1935 to 1943. She received a BS degree in education and social sciences from Farmville State Teachers College in 1943, and served five years in the U.S. Navy during World War II, attaining the rank of lieutenant commander.

In 1951 she graduated from the Duke University Law School, then was practicing staff attorney in the Duke University Legal Aid Clinic for two years. In 1953 she joined the staff of the Office of Ordnance Research, forerunner of the Army Research Office-Durham.

A major responsibility of the office she heads is to provide the services of outstanding and uniquely qualified scientists to Army R&D installations to give advice and assistance in problem areas.

Under Mrs. Boddie's supervision, the Scientific Services Program has assisted the assembly of study groups to work on major problems of Army-wide significance. Since 1956, the services of hundreds of America's leading scientists have been made available to user installations under this program.

Mrs. Boddie also serves as executive secretary and parliamentarian of the Army Mathematics Steering Committee, as executive secretary of the Senior Scientists Steering Group and of the Junior Science and Humanities Symposia Advisory Council, and is a member of the ARO-D Employe Training Review Panel.

In 1964 she received the Department of the Army Decoration for Meritorious Civilian Service.

SCIENTIFIC CALENDAR

Meeting of the American Chemical Society, New Orleans, La., Jan. 7-12.

Systems Approach to National Problems Forum, sponsored by AIAA and ORSA, Washington, D.C., Jan. 8-10.

Meeting of the Society of Automotive Engineers, Detroit, Mich., Jan. 8-12.

Annual Symposium on Reliability, sponsored by IEEE, Boston, Mass., Jan. 16-18.

U.S. Army Laboratory System Conference, sponsored by AMC and the AOA, Fort Myer, Va., Jan. 18.

6th Aerospace Sciences Meeting, sponsored by AIAA, N.Y.C., Jan. 22-24.

Conference on Methodologies of Pattern Recognition, sponsored by OAR, Honolulu, Hawaii, Jan. 24-26.

Spectrometric Identification of Organic Compounds Course, sponsored by ACS, Wilmington, Del., Jan. 26-28.

Winter Meeting of the American Society for Testing and Materials, Atlantic City, N.J., Jan. 28-Feb. 2.

Winter Power Meeting, sponsored by IEEE, N.Y.C., Jan. 28-Feb. 2.

2d International Conference on Photosensitization in Solids, sponsored by AFCRL, ONR, AEC and the Department of Health, Education and Welfare, Tuscon, Ariz., Jan. 29-31.

Meeting of the World Meteorological Organization, Geneva, Switzerland, January (dates undetermined).

3rd Middle Atlantic Regional Meeting of the American Chemical Society, Philadelphia, Pa., Feb. 1-2.

Paraplegic Recounts Channel Swim at WRGH

New hope for the future soared for a paralyzed young Army sergeant at Walter Reed General Hospital when paraplegic Harry Hinken, 42, recently returned from a 25-mile swim in the English Channel, told how he gained remarkable mobility through "patience and hard work."

Hinken, a Washington, D.C., insurance agency president, was paralyzed from the waist down after a polio attack in 1953. He spent three years in hospitals and had 19 operations, including the removal of both collar bones. His back muscles are unusable, he stated.

He told his story to patients in Walter Reed's neurosurgery ward, many of them veterans of the war in Vietnam, as encouragement for them to overcome their various disabilities.

The most excited listener was Sgt Michael K. Kovell, 23, of Seattle, Wash., paralyzed from the lower chest down by an auto accident in Germany last July.

Hinken told of his training for two years to swim the English Channel. Grease and oil deposits slowed him down in an attempt last September, and he could stay in the water only eight hours. He trains at Rehobeth, Del., with Sam Tinkham, former Olympic and Walter Reed Army Medical Center swimming coach. Next summer he hopes to complete a trans-Channel swim.

Using a double back brace that locks his legs in either straight or bent-knee position, Hinken walks with crutches and his own shoulder and arm power. While teaching himself to walk in this manner, his chest measurement increased from 43 to 50 inches. He said that doctors told him he'd never be able to walk more than half a block. "But I worked until I could walk over five miles."

He swam before becoming paralyzed and then realized that legs are used in swimming about as much as arms are in walking. He gradually increased his ability, using a freestyle and backstroke.

The tall, obviously once powerfully built Hinken swims half a mile every morning at a Northern Virginia club before driving himself to his agency office in Washington. He is also personnel director for the Washington Redskins professional football team band.

Honken's advice: "If you concentrate on your abilities instead of your disabilities; if you use what you have and forget about what you don't have, no one will be more amazed than yourself about what you can accomplish."

Sgt Kovell admitted that Hinken's accomplishments were beyond his comprehension but, "I can't wait to get started."

196 Authors Listed on 96 Papers for Army Science Conference

(Continued from page 31)

U.S. Army Medical Research and Nutrition Laboratory, Denver, Colo.; and

Thyroidal Dysfunction Following Exposure to Simulated Altitude, by Dr. Philip F. Mulvey Jr. and Joanne M. R. Macaione, U.S. Army Research Institute of Environmental Medicine, Natick, Mass.; *Cyanoacrylate Adhesives as Emergency Hemostatic Aids in Combat Casualties: Report of Seven Patients from Vietnam*, by Capt John A. Collins, Capt Paul M. James, Capt Sidney A. Levitsky, Capt Carl E. Bredenburg, Capt Robert W. Anderson, Col Harold S. Hamit, Col Robert M. Hardaway III and Dr. Fred Leonard, WRAIR.

CORPS OF ENGINEERS—*Blust Phenomeno from Explosions at the Water Surface*, by A. Sakurai, J. M. Pinkston Jr. and J. N. Strange, U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss.; *A Mathemotical Model for the Troversol of Rigid Obstocles by o Pneumutic Tire*, by A. S. Lessem and A. J. Green, WES; *Shock Pressures Resulting from Impact Between Solids and Liquids*, by A. M. Kamel, WES; and

Experimentul Techniques Applied to Stress Anolysis in Three Dimensions, by J. H. Hubbard, H. S. Kahn and J. R. Lowell, Ohio River Division Laboratories, Cincinnati, Ohio; *Geoid Determinotions*, by Irene Fischer, Army Map Service, Washington, D.C.; *The Use of Geopotential Heights for Greut Datum*, by C. B. Feldscher and R. M. Berry, U.S. Army Engineer District, Lake Survey, Detroit, Mich.; and

Hurricane Surge Determinations on the Texas Coast and in Galveston Boy, by J. W. Woodward, U.S. Army Engineer District, Galveston, Tex.; *Measurement of Organizotional Communicutions and Program Effectiveness*, by H. I. Shaller, Office of the Chief of Engineers, Washington, D.C.; *Formation and Engineering Characteristics of Explosively Produced Craters*, by B. C. Hughes, U.S. Army Engineer Nuclear Cratering Group, Livermore, Calif.

OTHER R&D AGENCIES—*Strategic ond Tocticol Implicotions of o Botunicol Barrier System*, by Capt R. L. Henshel and Lt Col O. E. Roberts III, U.S. Army Combat Developments Command, Fort Gordon, Ga.; *The Use of Arthropods as Personnel Detectors*, by Dr. Clyde S. Barnhart, U.S. Army Limited War Laboratory (LWL), Aberdeen Proving Ground, Md.; *Personnel Detection Using Low Frequency Rador*, by Louis V. Surgent Jr., LWL.

ARMY MATERIEL COMMAND—*Viscoelastic Rheology by Ultrasonic Interferometry*, by J. G. Parks, U.S. Army Tank-Automotive Center, Warren, Mich.; *Parametric Analysis for Selection of XV-11A Research Aircruft Configuration*, by Lt George Zuments, U.S. Army Aviation Materiel Laboratories (AVLABS), Fort Eustis, Va.; *Meosurement of Dnmping in Fiber Reinforced Plastics*, by Ernest B. Paxson and Arthur J. Gustafson Jr., AVLABS; and

Atmospheric Electrical Structure, by Willis L. Webb, White Sands Missile Range, N. Mex.; *Solution Lasers*, by 1st Lt Michael E. Gordon, U.S. Army Electronics Command (ECOM), Fort Monmouth, N.J.; *Millimeter Rodor—Radiometer*, by Robert H. Pearce and Capt D. Foiani, ECOM; *Advonces in Photo-Electrolytic Imoging Systems*, by Capt Michael C. Zerner, Capt James F. Sobieski and Harvey Hodes, ECOM; *An Electronic System for Locoting Friendly Patrols*, by Harold N. Tate, ECOM; and

Modulotable IR Emission of Alkali Vopors, by John E. Creedon and William Bayha, ECOM; *Conversion of Millimeter Wove Images into Visible Displays*, by H. Jacobs, R. Hofer, G. Morris and E. Horn, ECOM; *Atmospheric Propagotion of Injection Laser Rodiation for High Duta Rote Tronsmission*, by E. J. Schiel, R. R. Gammarino and E. Aras, ECOM; *The Mechonism ond Applicution of Periodic Electrode Processes*, by H. F. Hunger and J. E. Wynn, ECOM; and

Abnormal Propagotion of Acoustic Waves, by G. Kaschak, ECOM; *Narrow-Band Infrored Quontum Detector for 1.06, Laser Emission*, by J. G. Gaultieri, G. P. deLhery, T. R. AuCoin and J. R. Pastore, ECOM; *Ionic Sensors*, by John N. Mrgudich, ECOM; *Vector Dose-Rute Sensing: A New Dimension in Nuclear-Radiation Survey*, by Stanley Kronenberg, ECOM; *Calculation of the Horizontal Electric Field from a Predetermined Magnetic Field at an Air-Earth Interface*, by Donald B. Dinger and Janis Klebers, U.S. Army Mobility Equipment Research and Development Center (MERDC), Fort Belvoir, Va.; and

A Theoretical and Experimental Analysis of Quasistatic Magnetic Field Transmission through Circular Apertures, by John N. Bombardt Jr. and Ronald J. Bostak, MERDC; *Bond Character and the Metasobility of Plosophoric Groups of Military Significonce*, by Robert C. McMillan, MERDC; *The Opticol Discrimination System (ODS) Program*, by H. G. Woods, U.S. Army Missile Command (MICOM), Redstone Arsenal, Ala.; and

Liquid Metul Chelates os Bollistic Modifiers for Composite Solid Rocket Propellonts, by Jon N. Eikenberry, MICOM; *Fluidic Missile Controf Systems*, by B. J. Clayton, MICOM; *Interaction of Hot Electrons with Optical Modes of Luttice Vibrntions*, by J. S. Bennett, E. L. Wilkinson and R. L. Hartman, MICOM; *A New Method of Depositing Silicon Curbide for High-Modulus Fibers*, by Vernon A. Nieberlein, MICOM; *Combined Stress Test Methods und Strength Results for Ceromic Materials*, by Richard E. Ely, MICOM; and

Development of a Method for the Utilizotion of Soy Protein as o Row Material Nutrient, by Thomas E. Shook, Bill M. McClure and John J. Berky, Pine Bluff (Ark.) Arsenal; *Neutron Diffroction Study of a-Pb$(N_3)_2$*, by C. S. Choi, Picatinny Arsenal, Dover, N.J.; *Mechanism of Thermal Decomposition of HMX*, by B. Suryanarayana, J. R. Autera and R. J. Graybush, Picatinny Arsenal; *Pressure Enforced Ferroelectric to Antiferroelectric Phase Tronsition*, by Philip Houser, Picatinny Arsenal; and

Houser, Picatinny Arsenal; and

Rocket Assisted Artillery Projectiles, by Arnold A. Novack, Frederick H. Menke, Stephen J. Harnett and John Smolnik, Picatinny Arsenal; *Theoretical Calculotions of the Electronic Structure of the Azide Ion*, by P. J. Kemmey, Picatinny Arsenal; *Air Beoring Inertial Height Sensor*, by George R. Taylor, Picatinny Arsenal; *Controlled Degradation of Steel*, by J. D. Corrie and H. Markus, Frankford Arsenal, Philadelphia, Pa.;

Studies Reluting to the Use of Propellant Gas, by Charles J. Litz Jr., Frankford Arsenal; *Synthesis of Stereoisomeric Incopacitating Agents*, by H. S. Aaron, G. E. Dudley, W. J. Lennoz and J. I. Miller, Edgewood Arsenal, Md.; *Chemicol Detection of Incopacitating Agents*, by Edward J. Poziomek and Eleanor V. Crabtree, Edgewood Arsenal; *Electron Immunocytochemistry*, by Edward J. Donati, John P. Petrali, John J. Cuculis and Ludwig A. Sternberger, Edgewood Arsenal; and

Comparotive Ballistic Effectiveness by Means of Serial Serum Enzyme Levels, by Maj Samuel A. Tisdale, Edgewood Arsenal; *The Metabolism of Riot Control Agents CA, CS ond CN*, by Capt S. A. Cucinell, R. K. Biskup, K. C. Swentzel and H. Snodgrass, Edgewood Arsenal; *Protection ond Reversol of Lethol Mustard Damage Resulting in Recovery of Cell Viability*, by Bruno Papirmeister, Claire L. Davison and Clark L. Gross, Edgewood Arsenal; *Lethal Effects of on Incapacitating Agent*, by Maj James A. Vick, 1st Lt Phillip L. Taylor and Sp/5 Richard M. DeGraaf, Edgewood Arsenal, and Frederick Klein, Bill G. Mahlandt and Norman S. Remmele, Fort Detrick, Md.; and

Host Influence on the Charocteristics of VEE Virus, by Fred P. Heydrick, Ralph F. Wachter and James X. Dwyer, Fort Detrick; *Application of the Scientific Method in Anolyzing the Man-Weopon Combination in a Combat Test Environment*, by Col James I. Muir, Fort Benning, Ga.; *A Micro-Assuy for Stophylococcal Enterotoxin B*, by Lothar L. Salomon and Richard W. Tew, Dugway Proving (Utah) Ground; *A Numericol Method for Evaluating Stresses in Gun Tubes*, by Royce E. Beckett, U.S. Army Weapons Command (WECOM), Rock Island (Ill.) Arsenal; and

Stress Reversal in Bonding Material between Fibers, by M. A. Sadowsky and S. L. Pu, Watervliet (N.Y.) Arsenal; *The Relotionship between Pressure Effects upon Fracture Mechanisms and Ductility and its Practicol Implicotions*, by T. E. Davidson and C. Nolan, Watervliet (N.Y.) Arsenal; *Rodiometric Measurements at 300 GHz*, by S. Y. Chang and J. D. Lester, Frankford Arsenal, Philadelphia, Pa.; *A System for Measuring Dynamic Flow Properties in Airfoil Boundary Layers*, by Enoch Durbin, Ames Research Center, Moffett Field, Calif.; and

Boundary Luyer Studies on Helicopter Rotors in Forward Flight, by W. J. McCroskey, Ames Research Center; *Explosive Reactions of N-F Compounds with Hydrogen*, by Lester P. Kuhn and Carl Wellman, U.S. Army Ballistic Research Laboratories (BRL), Aberdeen Proving Ground (APG), Md.; *New Knowledge on the Fundamentul Limitations to Operation of Field Effect Transistors*, by K. A. Pullen, BRL; *The Hazard Profiles of Laser Reflections from Military Targets*, by J. W. Brown, BRL; *Minimum Weight Design of Elastic Structural Elements*, by Capt Edward J. Haug Jr., WECOM; and

Homogeneous Nonionic Detergent, p-n-Nonylphenoxydecaethoxyethanol, by Marjan Kolobielski, U.S. Army Coating and Chemical Laboratory, APG, Md.; *Self-Diffusion of Sodium Ions in Frozen Bentonite*, by Capt R. P. Murrmann and P. Hoekstra, U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, N.H.; *Associated Ytterbium and Niobate Impurities in Calcium Tungstate*, by Joseph Nemarich, Harry Diamond Laboratories (HDL), Washington, D.C.; *Radiation Induced Fracture of Silicon ond Germanium*, by R. B. Oswald Jr., H. A. Eisen and D. R. Schallhorn, HDL; and

A Pulsed UHF Transistor Oscillotor with Rapid Rise and Phase Control, by H. I. Bassen, HDL; *Inductive Proximity Sensor*, by Hans W. Kohler, HDL; *Laser Beam Disrupter*, by Z. G. Sztankay and R. J. Holland, HDL; *Shock Avoidnnce as o Chronic Psychological Stressor: An Evoluation*, by Murray D. Levine, U.S. Army Human Engineering Laboratories, APG, Md.; *Chemical Thermodynamic Properties of Heteronuclear Diotomic Molecules of the Trunsition Metal Elements and Germonium*, by Arthur Kant and Bernard Strauss, U.S. Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass.; and

Large Nonsymmetric Deflections of Thin Shollow Shells, by John F. Mescall, AMMRC; *A New Concept in Lightweight Armor Penetrntors—Duol Hordness Projectiles*, by S. J. Doherty, AMMRC; *Freeze Desiccation—A New Method of Food Preservotion*, by Jurgen Strasser, John G. Kapsalis and J. Walter Giffee, U.S. Army Natick (Mass.) Laboratories (NLABS); *HILIS—A High Intensity Light System for Food Production*, by Robert O. Matthern, NLABS; *Water Vapor Permeability in a Polyester Based Polyurethane*, by N. S. Schneider, L. V. Dusablon and L. A. Spano, NLABS; and

Ballistic and Mechanicol Properties of Oriented Polymers, by Capt David M. Martin and G. R. Thomas, NLABS; *Quontitotive Effects of Physical Parameters of Ceromic Components upon Ballistic Performonce of Ceramics/Plastic Composite Armor*, by Morton I. Kliman, NLABS; *A New Approoch to Protection Against Intense Light Energy*, by R. A. Prosser and J. T. Stapler, NLABS; *A Ferroelectric Gammo-Ray Spectrometer*, by J. H. McNeilly, U.S. Army Nuclear Defense Laboratory, Edgewood Arsenal, Md.; and

Bomblet Launchers which Simulate Aircraft Release, by V. Pratt, Deseret Test Center, Fort Douglas, Utah, and H. Rantala, Tooele (Utah) Army Depot; *Prediction of Meteorological Data in Regions of Poor Data Coverage for Employment in Observational Grid Design*, by H. Greenfield, Deseret Test Center; *MBT-70 Mission Profile*, by Lt Col Warren L. Ammentorp, U.S. Element, MBT Joint Engineering Agency, Warren, Mich.

Supplemental papers are as follows:

OFFICE, SURGEON GENERAL—*Chikungunya Vaccine Project*, by V. R. Harrison, WRAIR; *The Development of a Laborotory Model for the Transmission of African Trypanosomiasis*, by Dr. Ronald A. Ward, WRAIR.

CORPS OF ENGINEERS—*Finite Element Techniques in Rock Mechanics*, by L. H. Blakey, Office, Chief of Engineers, Washington, D.C.; *Second Order Regression Processes in Geometric Satellite Data Reduction*, by L. A. Gambino, U.S. Army Engineer Topographic Laboratories, Fort Belvoir, Va.

OTHER R&D AGENCIES—*Effects of Spectrum Sampling on Speech Intelligibility*, by Anthony E. Castelnovo, U.S. Army Behavioral Science Research Laboratory, Washington, D.C.; *Problems of Controlled Bird-Flight*, by John J. Romba, LWL;

ARMY MATERIEL COMMAND—*An Optical Dato Link for Reol-Time Remote Measurement of Fast Transients in the Presence of Lurge Electromagnetic Fields*, by Harold R. Carey, MERDC; *A Parametric Study of Bioretardation*, by Larry Strudivan and John H. Thompson, Edgewood Arsenal, Md., and J. Y. Terner, BRL, APG; *Gnseous Halide Lasers*, by G. J. Dezenberg and J. A. Merritt, MICOM; and

Inhibition of Staphylococcol Enterotoxin B Formation by Cell Wall Blocking Agents and other Compounds, by Mischa E. Friedman, Fort Detrick, Md.; *Electroless Deposition of Nickel and Cobolt Based Alloys*, by F. Pearlstein and R. F. Weightman, Frankford Arsenal, Pa.; *Flash Blindness: The Effects of High Intensity Photic Stimuli upon the Cat Electroretinogram*, by David I. Randolph, NLABS; and

Analysis of Inertial Linear Fuzing Devices, by Ceslovas Masaitis, BRL; *Alknli Metal Vapor Studies*, by D. C. Fromm, ECOM; *The Barium Oxide Molecular Beam Tube, A New Type of High Precision Frequency Source*, by H. Helwig, ECOM.

"MISSILE PARK," White Sands Missile Range, N. Mex.

WSMR Adds 4 Missiles to Outdoor Museum

Pershing, Athena, Tartar and Terrier recently became the latest missiles to join 31 others in "Missile Park," the world's first and largest outdoor missile museum, located at White Sands Missile Range (WSMR), N. Mex. Twenty of the missiles are being tested; 15 are obsolete.

The museum dates back to the end of World War II when trainloads of captured German V-2 parts were unloaded in Las Cruces, N. Mex., and transported to the national range for test and development programs.

The V-2 was assembled and launched from WSMR in April 1946, and was America's first rocket to carry a heavy payload to high altitude, and the first large missile to be controlled in flight. The rocket, 46 feet long with a 5.5-foot diameter, traveled at 3,500 miles per hour and had a 200-mile range. It weighed more than 28,000 pounds.

First among the newer additions, the Army's long-range Pershing was launched at WSMR in August 1963. The needle-nosed, 2-stage ballistic missile has been fired from southeastern Utah to impact at WSMR, covering distances of more than 400 miles. Pershing is 35 feet long, weighs 10,000 pounds and has a nuclear capability.

The Pershing ground support equipment carriers will be converted from tracks to wheels for greater road mobility. It will have an erector-launcher that can carry the missile on a single carrier, and will be towed by the 5-ton M656 truck.

Athena, a multistage, reentry research vehicle, was first fired in 1964. The 50-foot-long Air Force missile is fired from Green River, Utah, and tracked through reentry by automatic antennas at WSMR.

Athena is the first missile system being tested at WSMR to use ultrahigh frequencies (UHF). All telemetry users must vacate the VHF (very high frequency) band and move to UHF by 1970.

Tarter and Terrier, sister surface-to-air missiles are being tested for fleet air-defense by the U.S. Naval Ordnance Missile Test Facility at WSMR. Terrier is 2-stage and weighs 3,000 pounds; its 15-mile range is five miles greater than that of the single-stage Tarter.

Holding the title of "the largest missile in the park," the 69-foot, 30-ton Redstone was deployed in Europe and is now being fired in Australia. The Redstone displayed in Missile Park is a sister model of the propulsion vehicle that lifted U.S. astronaut Comdr Alan Shepard on his space flight.

In contrast to the giant Redstone, the museum's midget missile is the Loki, used by the Army as an upper-air research vehicle. Loki's 24-pound frame measures 103 inches with a 3-inch diameter.

Other missiles include the Dart antitank missile which was first fired at WSMR in August 1964, and the 14-foot-tall Lark which was launched in 1944.

The Aerobee Hi was donated to the park in 1960. It was first fired in September 1947, and is being used by the U.S. Navy and Air Force as an upper-atmosphere research rocket.

Ten years after its first WSMR firing, the Aerobee set an altitude record of 190 miles for single-stage rockets. One of the range's slimmer missiles, the Aerobee has a diameter of 15 inches, a height of 16 feet, and a speed of 6,800 feet per second.

Since the first V-2 display, the missile park has been a main attraction at WSMR for hundreds of visiting dignitaries, scout troops, civic groups, and military and civilian government personnel.

Lance Ends Phase of Environmental Tests

Lance, the Army's newest surface-to-surface missile, recently completed the tropical environmental and operational phase of the engineer design test at the U.S. Army Tropic Test Center, Panama Canal Zone.

In the first phase of testing, the missile and its major components were placed in storage at Fort Sherman. Regular inspections were made to determine resistance to fungi, corrosion, high humidity and salt-laden air.

The operational portion of the tests included simulated firings of the missiles and 3,000 miles of mobility runs in three tropical environments — jungle trails in evergreen rainforests, tropical savanna grass and swamp areas.

Even though parts of the new weapon system were previously tested in environmental chambers, various potential problem areas were uncovered during the tests in the natural environment.

Lance combines the reliability and low cost of a free rocket with the range and accuracy of a guided missile. Rugged and simple to operate, it gets its accuracy from a simplified internal guidance and control system conceived and developed by the U.S. Army Missile Command, Redstone Arsenal, Ala.

The first Army missile to use a prepackaged, storable, liquid propellant, Lance and its launcher, mounted on a self-propelled track vehicle, form a self-contained and self-sustaining unit which can be dismounted and transported by helicopter or dropped by parachute.

Lance was designed to provide the Army with a highly mobile weapon for general support of infantry, armored, mechanized and airborne divisions.

Missilemen from Redstone Arsenal, a team from the U.S. Army Artillery Board, Fort Sill, Okla., and representatives of the U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Md., and other interested agencies were in the Canal Zone during the test period. Juan M. Calderon, TTC test engineer, was the Lance project officer.

LANCE MISSILE team conducts simulated firing mission during tropic environmental tests at U.S. Army Tropic Test Center, Panama Canal Zone.